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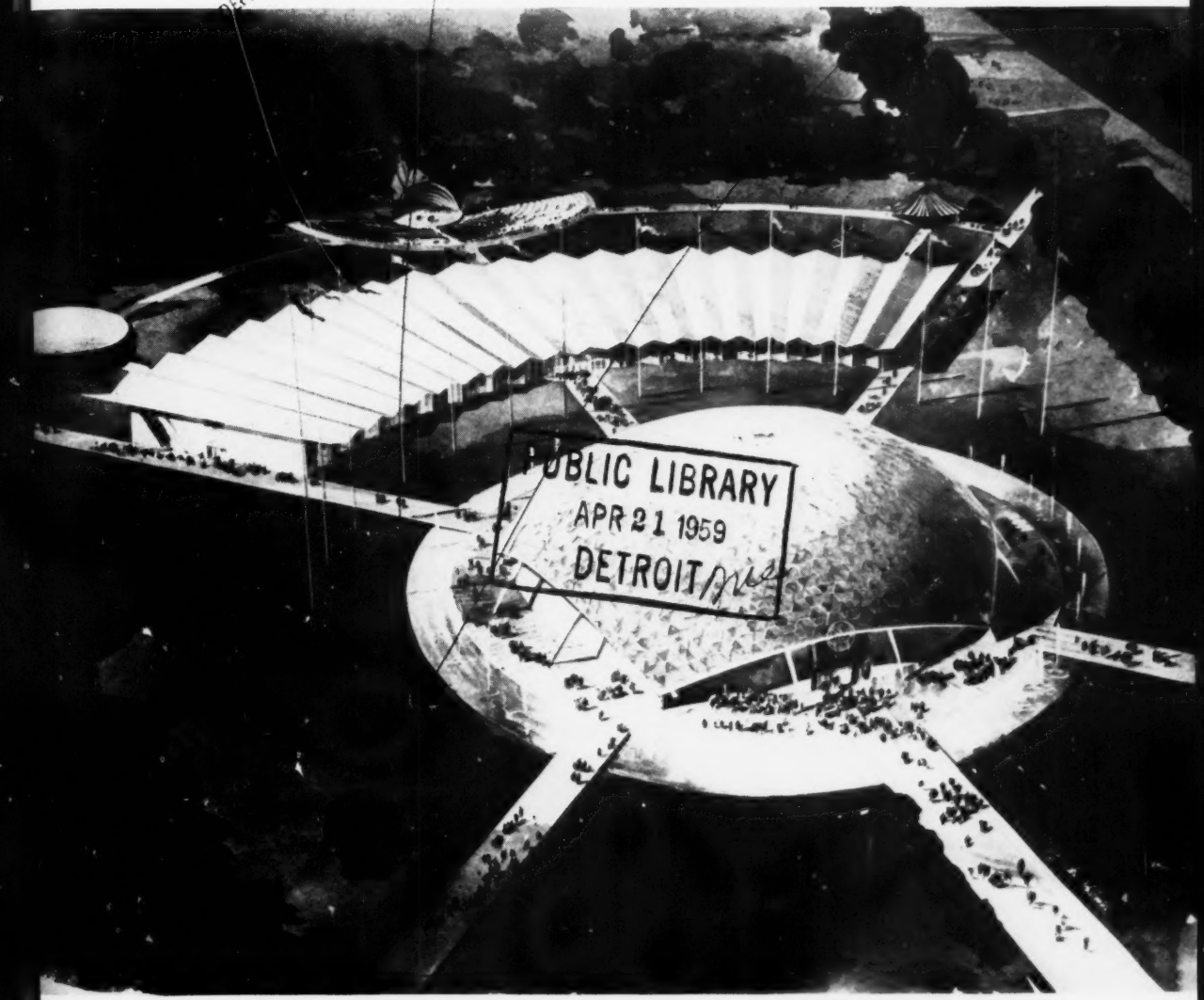

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American National Exhibit in Moscow This Summer Will Include Products Of Several Rubber Companies

See page 111

From Du Pont

ZENITE SPECIAL

an excellent accelerator with antioxidant qualities for natural rubber and SBR latices

ZENITE SPECIAL, together with an ultra accelerator, is widely used as the acceleration system of natural rubber and SBR latices. It coordinates the curing rate of latex foam with processing, providing a rapid wet cure, with no over cure in subsequent drying operations.

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Better Things for Better Living . . . *through Chemistry*

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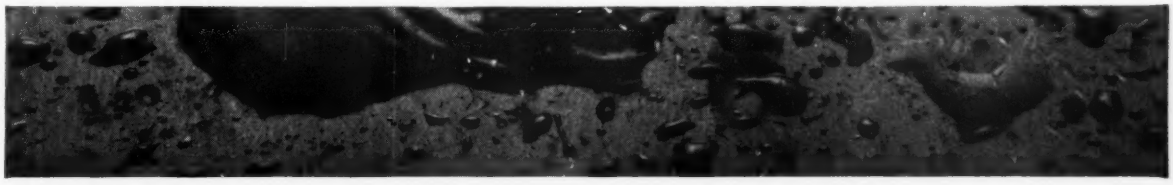
News about

B.F.Goodrich Chemical *raw materials*

HYCAR 1002



Even after years of research and development, there is no substitute for the excellent water resistance contributed by one of the original nitrile polymers, Hycar 1002. This unusually clean rubber proves ideal in applications where water may be a problem.

Hycar 1002 contributes other important properties, too, producing excellent stiffness without extra loading in the uncured state. It is an excellent polymer for use in extruded products or sponge—anywhere that stiffness during cure is important.

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And of course, Hycar 1002 supplies the properties users have come to expect from nitrile rubbers—heat resistance, abrasion resistance and solvent resistance. It's an example of lasting development in nitrile rubber to meet your compounding needs. Get information about 1002 or other Hycar rubbers by writing Dept. CB-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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ARTICLE HIGHLIGHTS

SOME ACCELERATOR RESIDUES IMPROVE AGING

The excellent age resistance of certain accelerator-cured rubbers has been shown to be due to inhibitors formed *in situ*. Residues formed in peroxide and radiation cured rubber detract from aging, however. **69**

MORE TIRE CORD ADHESION FACTORS DETERMINED

In a continuation of work reported in late 1957, it is emphasized that although the principal contribution to tire cord adhesion comes from the resorcinol formaldehyde resin, the chemical nature of the latex elastomer used can add or detract from this adhesion. **77**

MULTIPLE-PURPOSE RUBBER STABILIZER IN SBR

This concluding installment on Wing-Stay 100 shows its effectiveness in several types of SBR vulcanizates and its positive action as a metal deactivator in SBR polymers containing iron. **81**

INFLATION, DEVELOPMENT COSTS, PROFITS

More inflation may be just around the corner. Some companies are already finding it difficult to finance the proper amount of research and development on reduced profits. Industry growth depends on profits. **67**

URETHANES, OZONE, NEW RUBBERS, VULCANIZATION

A fine program, which includes symposia on urethanes, on the effect of ozone on rubber, and regular sessions on new rubbers and vulcanization, has been prepared for the Los Angeles meeting of the Rubber Division of the American Chemical Society. **86**

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VOLUME 140, NUMBER 1 APRIL, 1959

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The opinions expressed by our contributors do not necessarily reflect those of our editors

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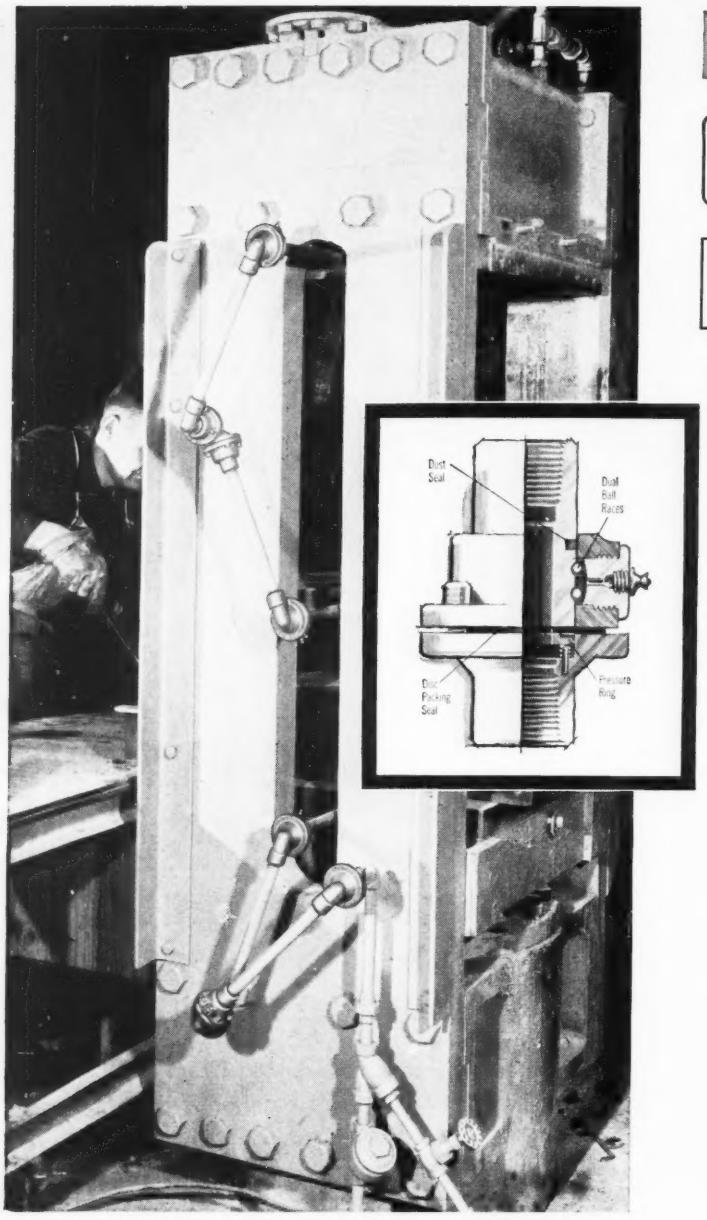

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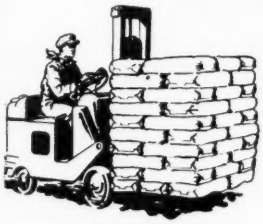

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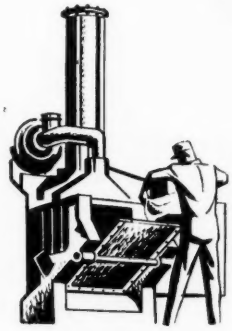
Thus you can handle Protox-166 faster and store it in a smaller space.



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Protox-166 is outstanding for dispersion. It disperses readily in any rubber under any weather conditions . . . because it is free of aggregates and its particles are coated with zinc propionate that is readily wet by rubber.

Protox-166 is outstanding for calendering and extruding. It provides smoother calendering with less shrinkage, smoother extruding with less die swell, and longer runs on strainers.

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* U. S. Patents 2,303,329 and 2,303,330

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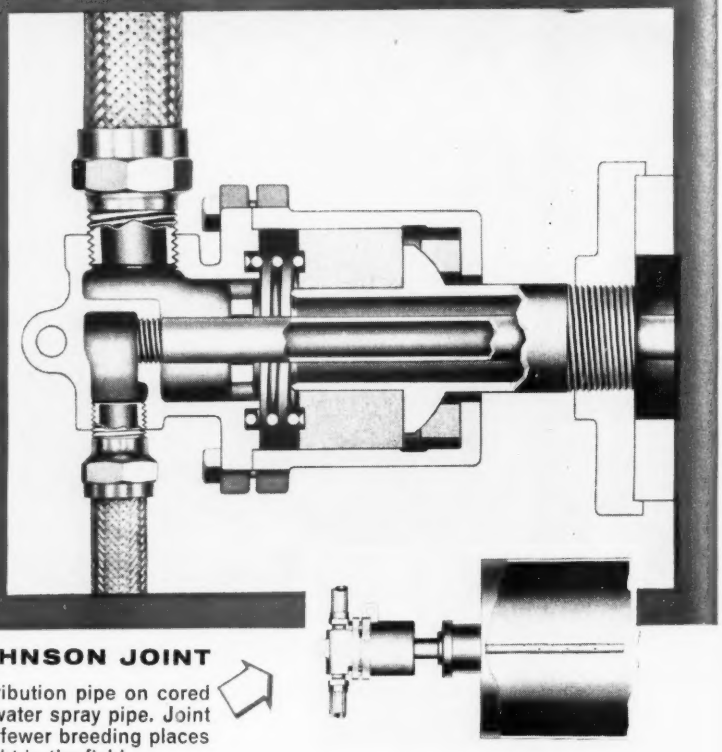

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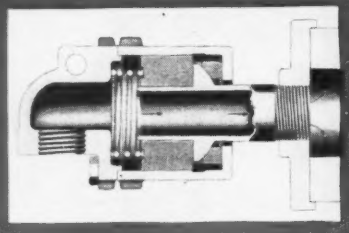
Used with stationary steam or water distribution pipe on cored rolls. See typical installation with chilled water spray pipe. Joint has only four internal parts, which means fewer breeding places for trouble and permits ready servicing right in the field.

TYPE SN JOHNSON JOINT

Used for rotating internal pipe applications. See typical installation on drilled roll. Assembly plate between head and body of joint facilitates mounting and inspection. The seal between rotating and stationary surfaces is still accomplished without any packing.



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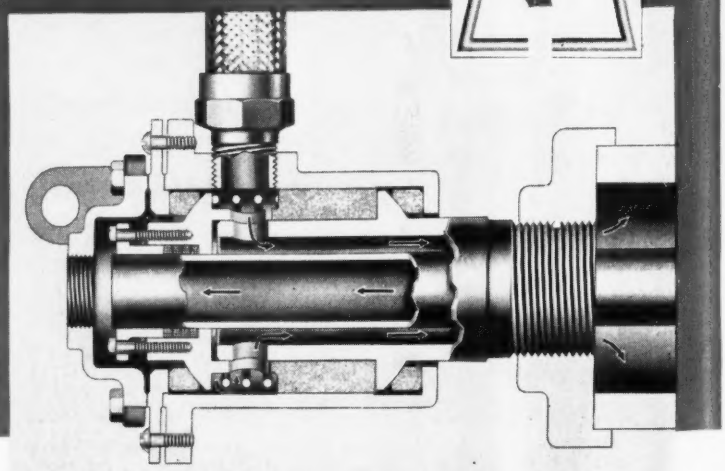
Type SA Johnson Joints are ideal for through-flow service on cooling rolls. They are compact in size, need no external supports.



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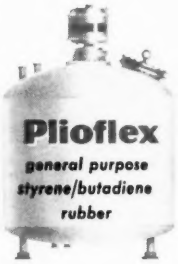

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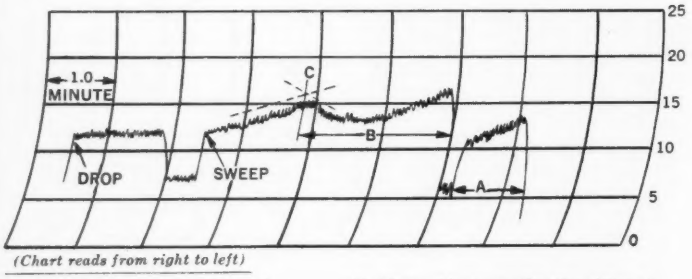
PROCESSABILITY TEST

Hypothetical Processability Test Chart



(Chart reads from right to left)

A. Polymer breakdown time interval **B.** Pigment incorporation time interval

C. Point of complete pigment incorporation

That's right! For the first time–in any rubber –you can be sure of processability–bale after bale, shipment after shipment.

How? Simply by specifying PLIOFLEX for all your styrene rubber needs.

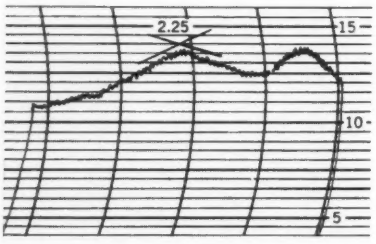
Why? Because Goodyear, through refinement of a previously developed test, has been able to establish a new control over processability.

Here's how it works: A laboratory Banbury is loaded with the polymer to be tested, under a specific set of operating conditions. The polymer is masticated. Then certain pigments are added and the time for their incorporation carefully determined.

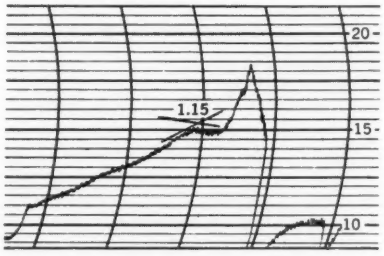
Pigment incorporation is the chart-indicated time, in minutes, from the point where the

*And here are the **A**ssured **P**rocessability*

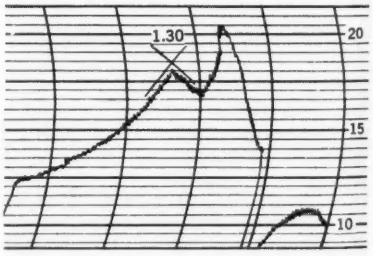
PLIOFLEX 1006 – **APF** = 2.40



PLIOFLEX 1500 – **APF** = 1.25

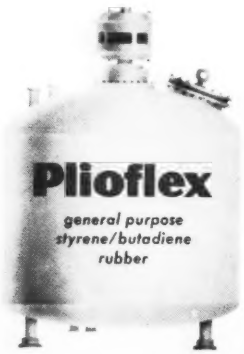


PLIOFLEX 1502 – **APF** = 1.40



NOTE: Shown above are typical Banbury power consumption charts for various PLIOFLEX rubbers. From these charts, maximum pigment incorporation times are determined and Assured Processability Factors established.

PLIOFLEX + Assured Processability



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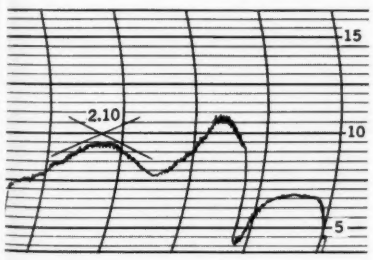
ou can have Assured Processability!

ram is lowered on the pigment-polymer mix to where there is a peak of power consumption followed by a sharp drop. Pigment incorporation time is an excellent gauge of polymer processability and, in hundreds of tests, has proved to be readily reproducible.

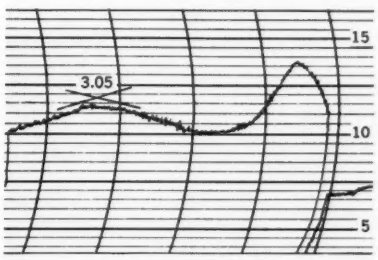
The result? Another industry first—assured processability. Goodyear has set up a production specification, based on maximum pigment incorporation time, which establishes a reproducible control over the processability of every type of PLIOFLEX offered. This means that no matter what type of PLIOFLEX you order, or when you order it, you will know its relative processability and know that it will be consistent. And this is something you could never before be sure of, in any type or brand of rubber.

ty Factors of typical PLIOFLEX rubbers:

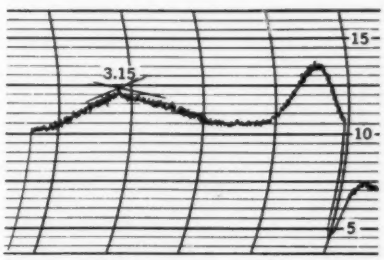
PLIOFLEX 1712 – **APF** = 2.25



PLIOFLEX 1773 – **APF** = 3.15



PLIOFLEX 1778 – **APF** = 3.25



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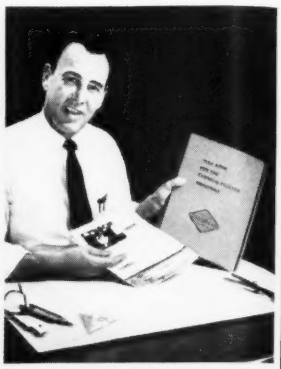

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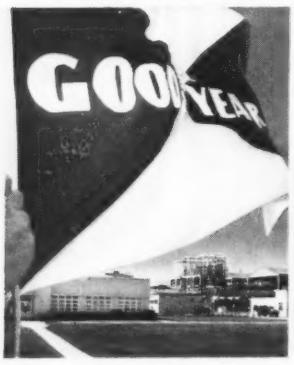

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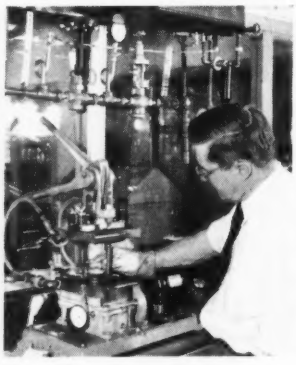

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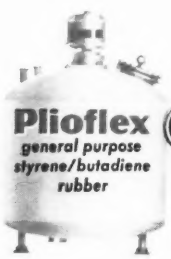

CHEMICAL
GOODYEAR
DIVISION

Rubber samples (ASTM bent loops) after 72 hr. exposure to 40 pphm ozone at 100° F. Severely damaged sample is a high-cost polymer cured 40 min. at 298° F. and supposedly stable against ozone attack. The other is an SBR formulation containing 3 phr UOP 88, cured 40 min. at 284° F.

NOW...prevent ozone damage, cut product cost, too!

SBR compound with UOP antiozonant withstands ozone better than supposedly stable high-cost polymer— yet costs substantially less!

The rubber test strips shown above tell a story that's mighty important to your profit picture. In addition to the obvious superiority of one over the other is this significant fact:

The test strip riddled with cracks is a high-cost polymer used for its resistance to ozone—the other a conventional SBR polymer protected with UOP antiozonant at substantially lower overall cost.

When you include UOP 88 or 288 in your formulation, the versatile chemical barrier slowly and uniformly migrates to vulnerable rubber surfaces—and thus keeps your product free of unsightly, degrading cracks throughout its entire life, regardless of the severity of conditions to which it may be subjected.

Using UOP 88 and 288 antiozonants you produce a top quality ozone-resistant product at minimum cost. Can you afford to do otherwise? Detailed information and samples are yours for the asking. Just write our Products Department.

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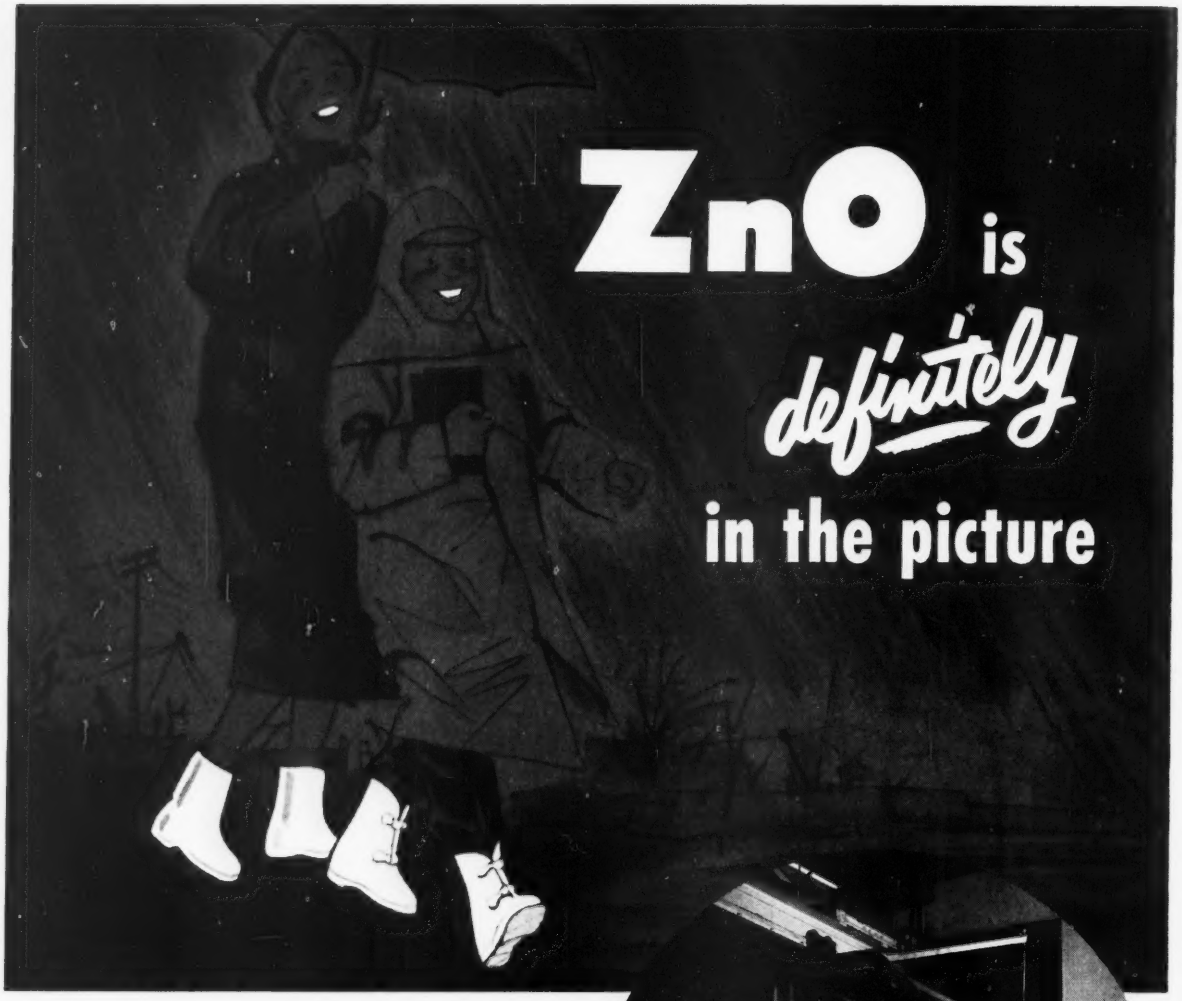


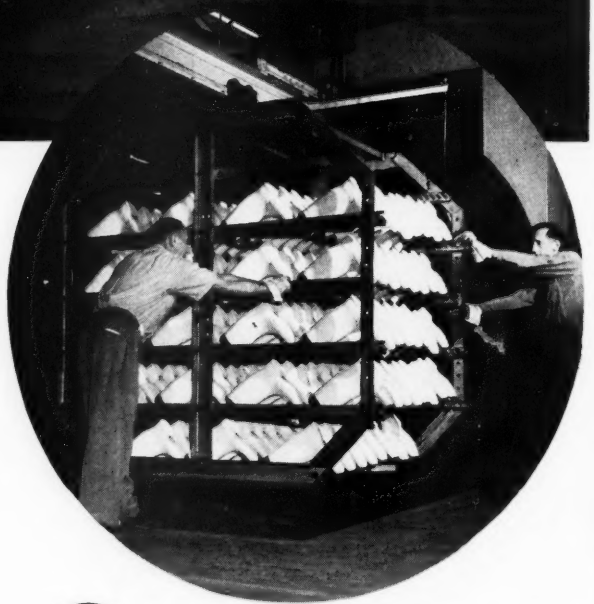
ST. JOE lead-free ZINC OXIDES were first produced by our unique electrothermic smelting process in 1931. Since then these pigments have found steadily increasing acceptance by the rubber industry as primary ingredients in their products.

The various reasons for this acceptance may be summed up thus: By virtue of years of experience with St. Joe pigments, consumers have come to know St. Joe's high and undeviating standards of quality and uniformity. *They rely on these factors to maintain or increase the quality of their own products.*

The earned preferential status enjoyed by our pigments in the rubber industry parallels the standing of other well-known products of this company — the largest producer of pig lead and one of the leading producers of slab zinc and lead-free zinc oxides in the United States.

SEND FOR YOUR FREE COPY

Our recently published 55-page Technical Data Book describes in detail each ST. JOE RUBBER GRADE ZINC OXIDE, and is available — with our compliments — to Purchasing Agents and Technologists.



Car loaded with white Grenadier Gaytees is pushed into a gigantic vulcanizer for curing.

Courtesy: U. S. Rubber Co.

ST. JOSEPH LEAD CO.

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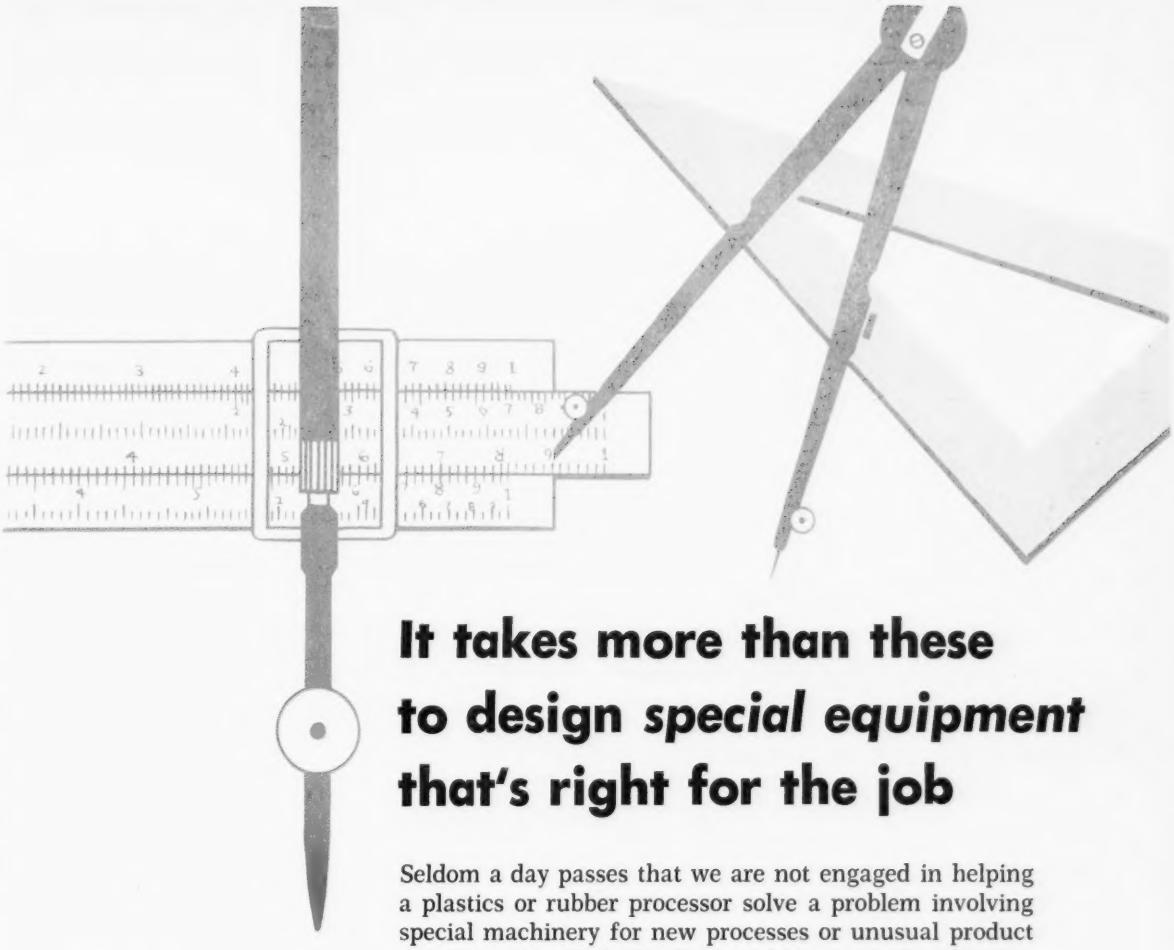
Plant & Laboratory:
Monaca (Josephtown), Pa.

ZNO-102



It takes more than these to design *special equipment* that's right for the job

Seldom a day passes that we are not engaged in helping a plastics or rubber processor solve a problem involving special machinery for new processes or unusual product requirements. Undoubtedly one big reason for the outstanding success of this phase of our business is that important extra "tool" Adamson United brings to the job . . . the wealth of specialized knowledge gained through more than 65 years of intimate contact with these industries.

Do you need special equipment for a new process? A new design to cut production costs, increase production or improve product quality? Our engineers, who are thoroughly familiar with today's plastics and rubber processing problems, have provided hundreds of manufacturers with equipment that meets these requirements exactly. Adamson United is ready to go to work for you, with a complete service from blueprint to installation. Why not call us in to discuss your particular problems? No obligation, of course.

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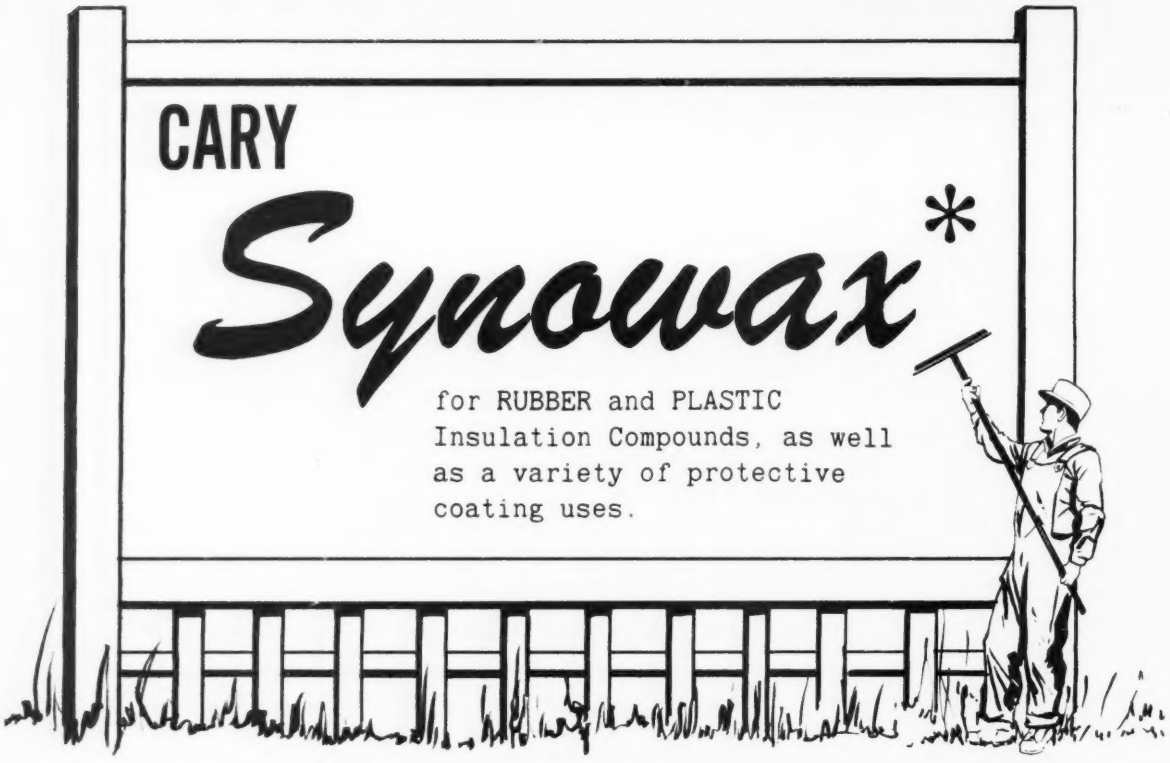

*Trade name for Cary Chemical's line of high melting point synthetic waxes.

Cary SYNOWAXES — high melting point synthetic waxes have good electrical properties, making them ideal for insulation compounds.

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FR-S 146 has a lower plasticity than similar copolymers, making it adaptable for rapid mixing and high loading in the processing of light-colored and non-staining goods.

FR-S 154 offers important day-to-day uniformity in the compounding of camelback, tire treads and mechanical goods.

FR-S 155 is an extremely stable oil-extended rubber to which additional oil can be added for low-cost production of camelback, tire treads and mechanical goods.

FR-S 158, combining the stiffness of high styrene resin with the flex resistance of rubber, is a masterbatch prepared in the latex state for more perfect dispersion of resin. Ideal for shoe soles and other light-colored products.

FR-S 181 offers reduced mixing time, needs no peptizing agents in the manufacture of chemically blown sponge. Easily processed, too, for mechanical goods and adhesives.

FR-S 1009 is used with other rubbers to improve smoothness and speed of calendering or tubing, and to avoid distortion of uncured products. Widely used in insulated wire, hose, sheet goods and coated fabrics.

FR-S 1010 features a very low polymer viscosity, reduces milling time and requires no peptizing agents in the manufacture of chemically blown sponge. Useful, too, in mechanical goods and adhesives.

Each of these Firestone polymers is designed to provide specific product characteristics and production economies. Firestone Technical Service stands ready to help you choose exactly the right synthetic rubber or latex for the job from the largest and most complete line of product-specialized polymers in the industry. Write today. *Firestone Synthetic Rubber and Latex Company*, Akron 1, Ohio.

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Chemical Manufacturers

NEW PROTECTION FOR RUBBER AGAINST OZONE

Detero®* Wax Beads are a pleasure to work with . . . pour, measure and disperse easily . . . no more slabs to run your labor cost up or messy flakes. Detero Wax Beads are tried and tested. Used in rubber formulations they have definitely given superior protection against weather and ozone. They will not stick in hot weather or hot mill rooms, will speed processing and improve your product. Also available for vinyl plastics.
Free-flowing Detero Wax Beads are the only such waxes available in this new, improved bead form . . . assure you of uniform mix every time. Manufactured by: Arrow Laboratories, Chicago. Distributed by the C. P. Hall Company.

*Process patent applied for

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The Comet "600" Laboratory Aging Block is designed for test-tube aging similar to ASTM Method D-865-52-T and aging in various fluids including oils and fuels at controlled temperatures from 100° to 600° F. Individual test tubes eliminate circulatory air contamination since each is isolated from the others. Built-in heating elements and temperature controls guarantee even heat and prevent hazardous noxious fumes. Precision machined of aluminum, it has a removable bottom plate for easy maintenance. All external parts are baked enamel or chrome plated.
Partlow Indicating and Proportioning-Type Thermostats insure exact temperature . . . all units are pre-calibrated at the factory. 15 inches high. 18 inches in diameter. Weighs 175 pounds. Also equipped with secondary temperature control, integral with block that prevents override of master control unit. Manufactured by: Product Packaging Engineering. Sole distributors: The C. P. Hall Company.

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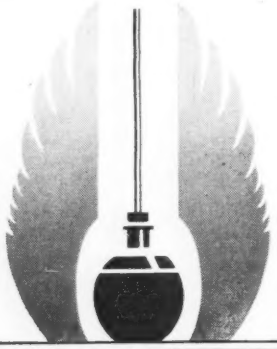

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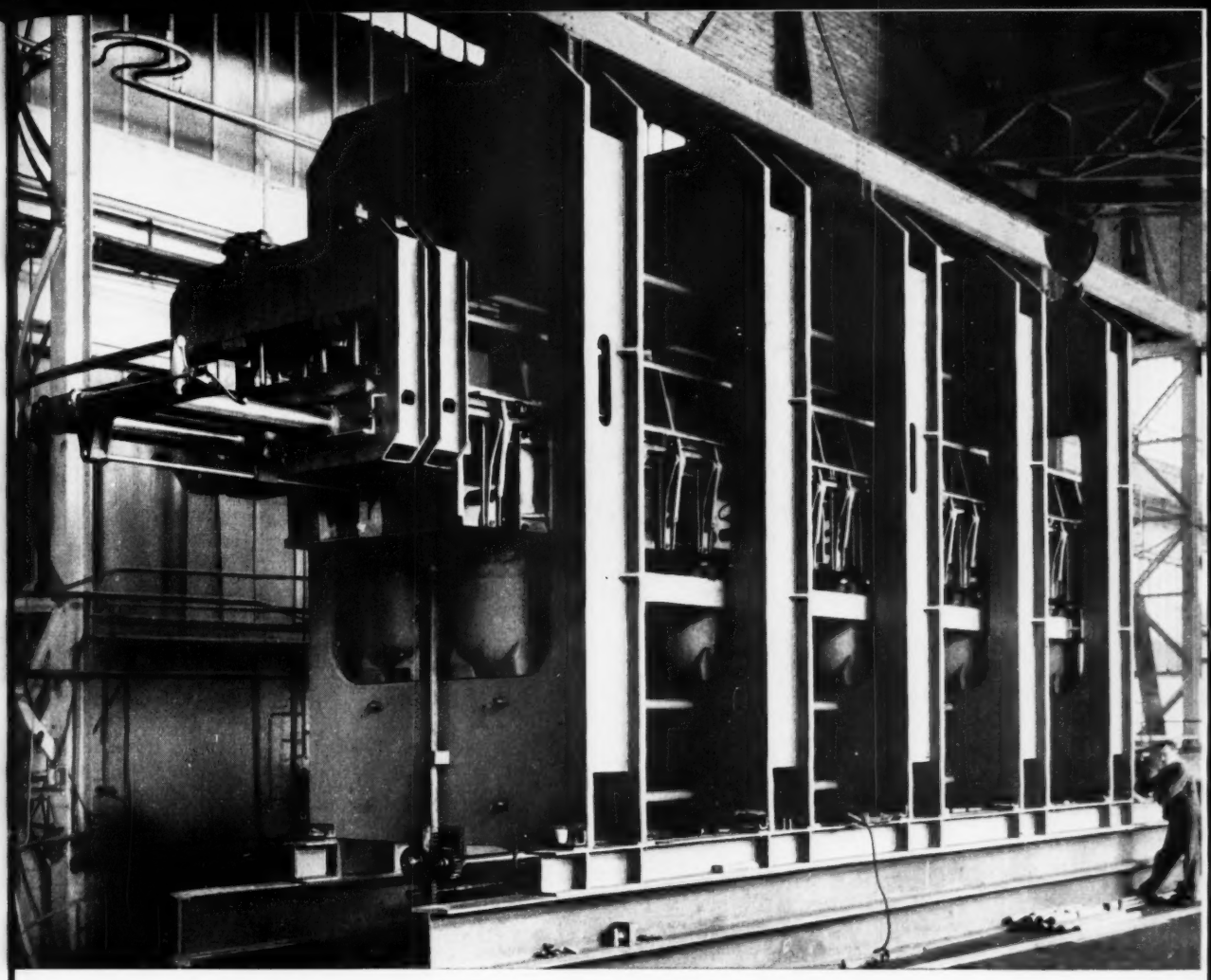

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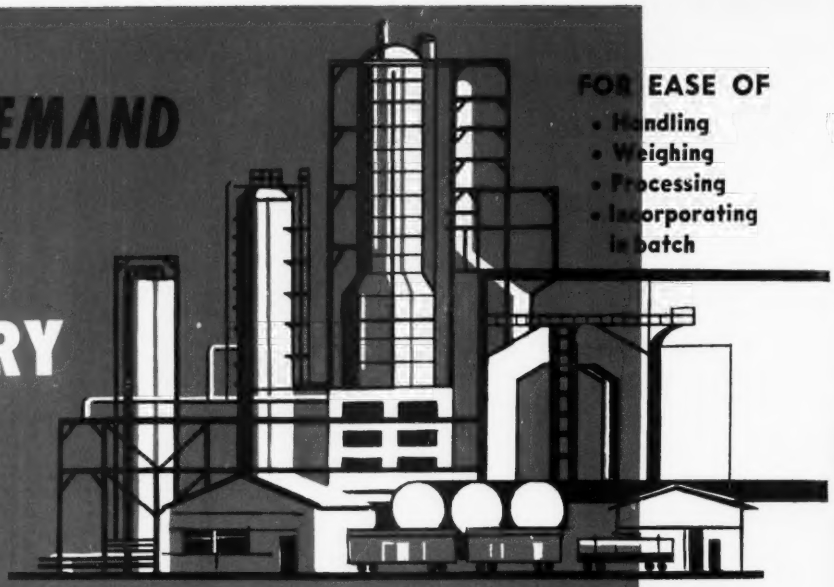

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Color	Amber	Odor	Characteristic
Specific Gravity	1.11	Toxicity	Not known to be toxic

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The vehicle rode on solid rubber tires, and heavy rubber strips that spiraled around a roller beneath it forced wet debris into the gutter as the truck moved along the streets.

Without rubber the development of such equipment would have been impossible. Without continuous developments in scientific rubber compounding, progress in all transportation fields would still be hardly beyond the "horse-drawn" era.

UNITED CARBON BLACKS have been specified by discerning compounders for practically every rubber application for more than three decades. UNITED CARBON BLACKS are made to meet today's — and tomorrow's — needs!

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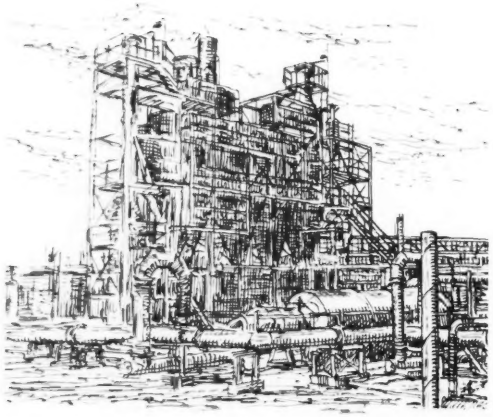

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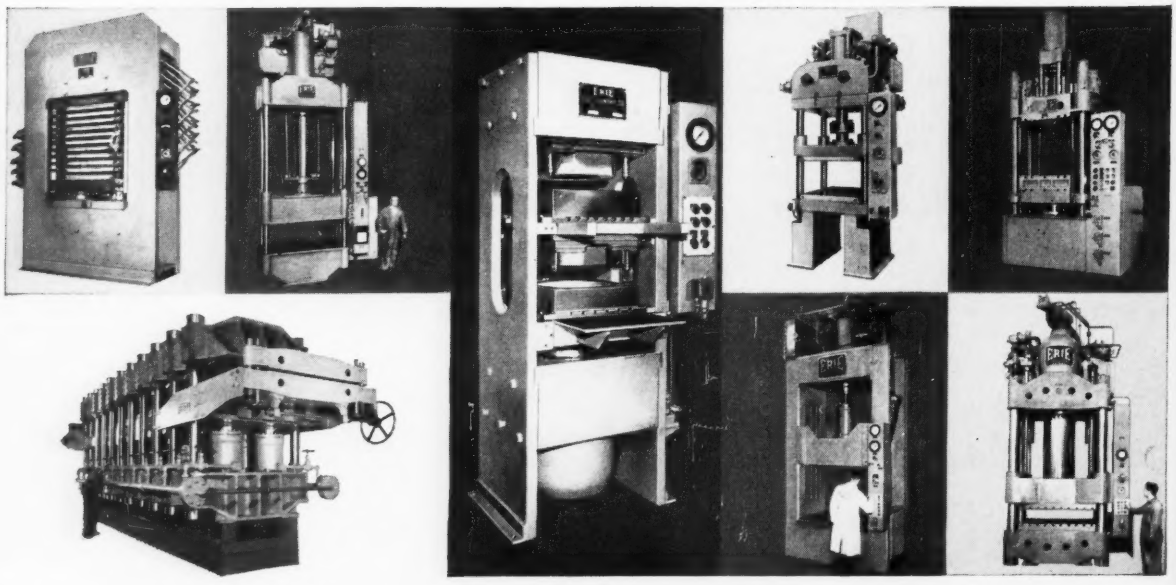

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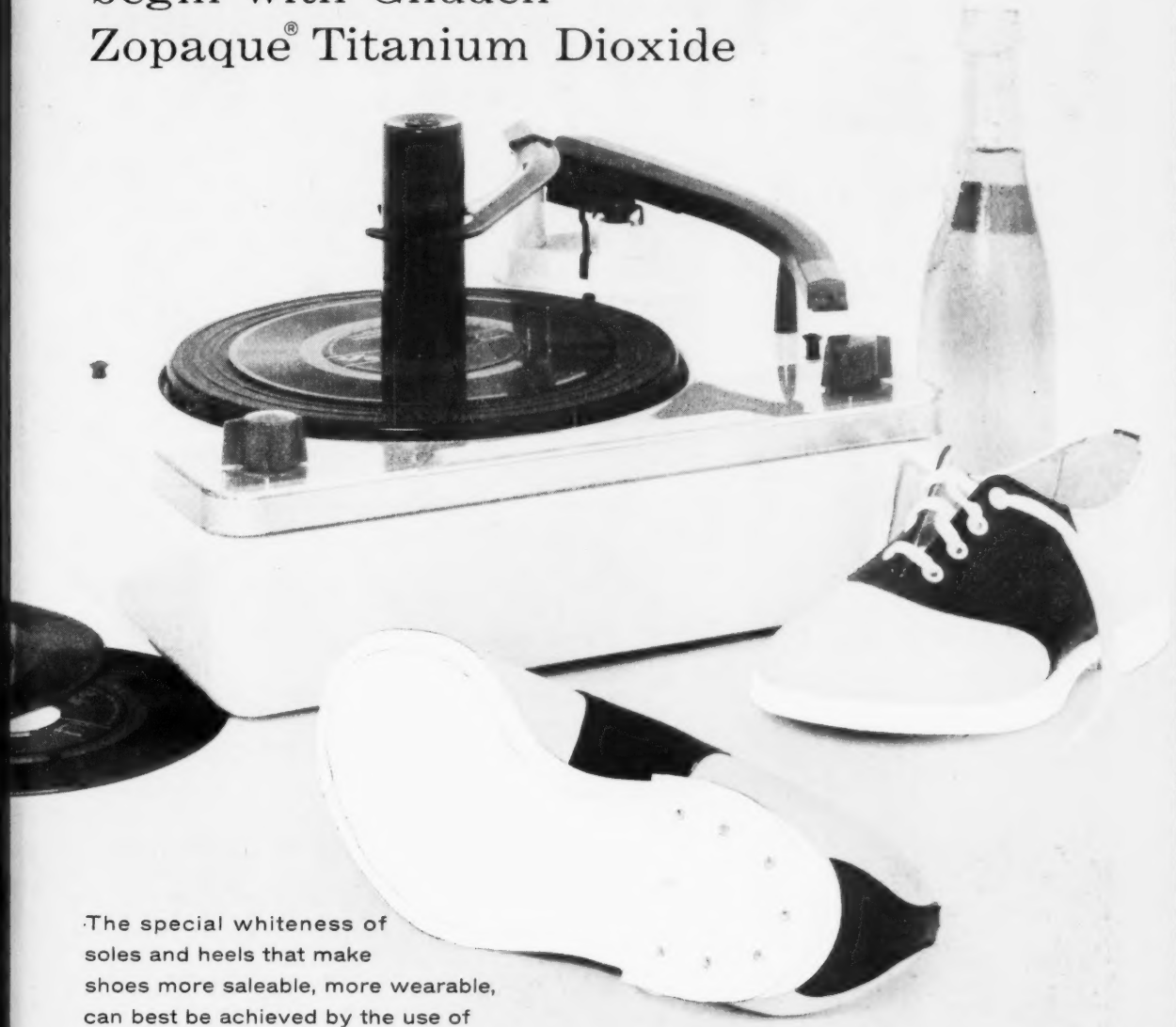

The special whiteness of soles and heels that make shoes more saleable, more wearable, can best be achieved by the use of Glidden Zopaque Titanium Dioxide. The outstanding optical and physical properties of Zopaque make it ideal for white rubber compounding. It imparts maximum opacity and high hiding power; assures maximum resistance to sunlight and weather.

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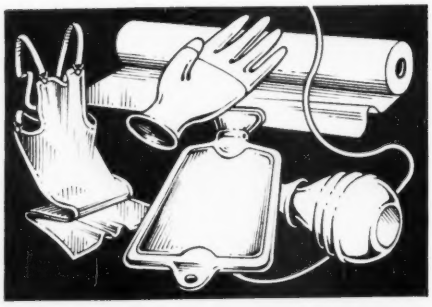

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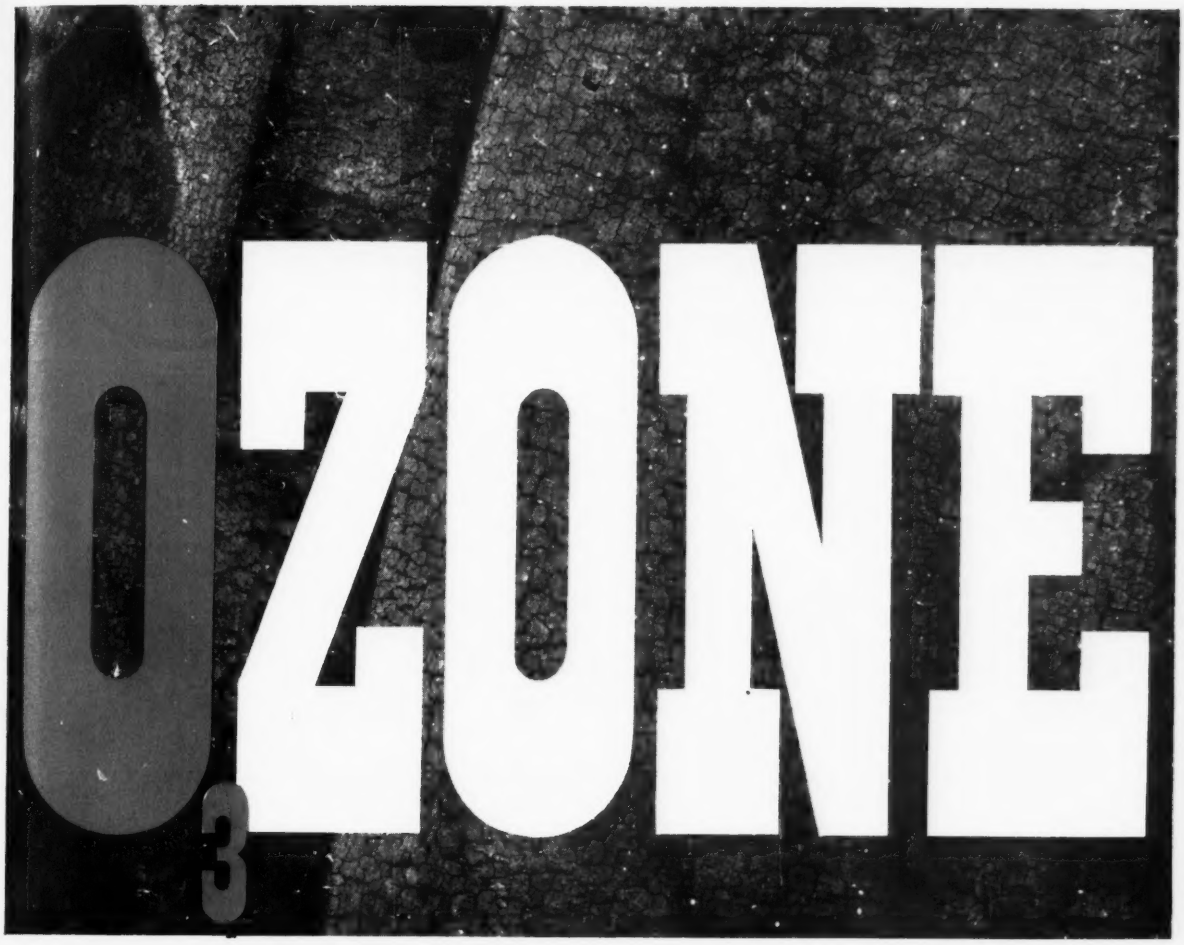

How to arrest its attack on rubber products

Ozone attack is now recognized as the major cause of cracking and checking in stressed rubber products.

The mechanism of this type of deterioration is attributed to the chemical attack of ozone upon the carbon-to-carbon double bonds of unsaturated elastomers. Through a rather complex reaction the double bond is broken. This places additional stress upon adjacent chains and increases their sensitivity to ozone attack. Thus a continuing reaction occurs, leading to the development of fissures perpendicular to the direction of the stress.

To combat the deteriorating effects of ozone, rubber chemists have several approaches open to them:

(1) Addition of waxes which migrate to surface areas

(2) Protection of surface areas with an inert coating

(3) Incorporation of antiozonants

Of these three methods, the use of antiozonants is the most effective for rubber products under stress. Antiozonants are easily incorporated into the rubber during processing and slowly exude to the surface during use. Because they interrupt the chain-breaking reaction between ozone and unsaturated elastomers, antiozonants provide a continuing protection which cannot be equalled by any physical method.

Eastman's Eastozone antiozonants protect rubber products more effectively at lower cost than do other types of commercially-used antiozonants. Using Eastozone antiozonants, compounders often can cut antiozonant requirements in half and still get the same ozone resistance, measured by static or dynamic exposure tests.

Give your mechanical goods or tire stocks maximum service life at minimum cost by incorporating Eastozone antiozonants in your rubber recipes. Ask your nearest Eastman representative for samples of Eastozone antiozonants or write to EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Eastozone **Eastman Rubber Antiozonants**

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; Atlanta; Chicago; Cincinnati; Cleveland; Framingham, Massachusetts; Greensboro, N. C.; Houston; New York City; St. Louis. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

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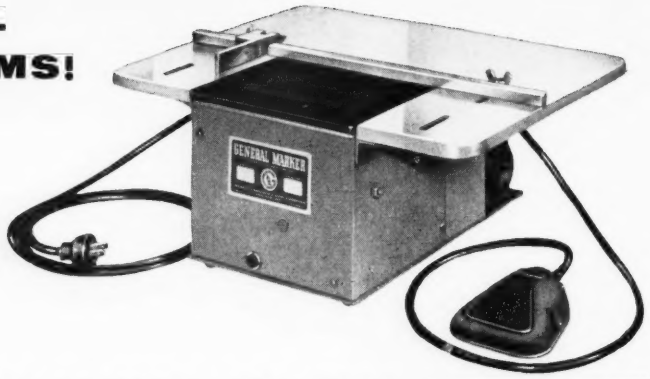

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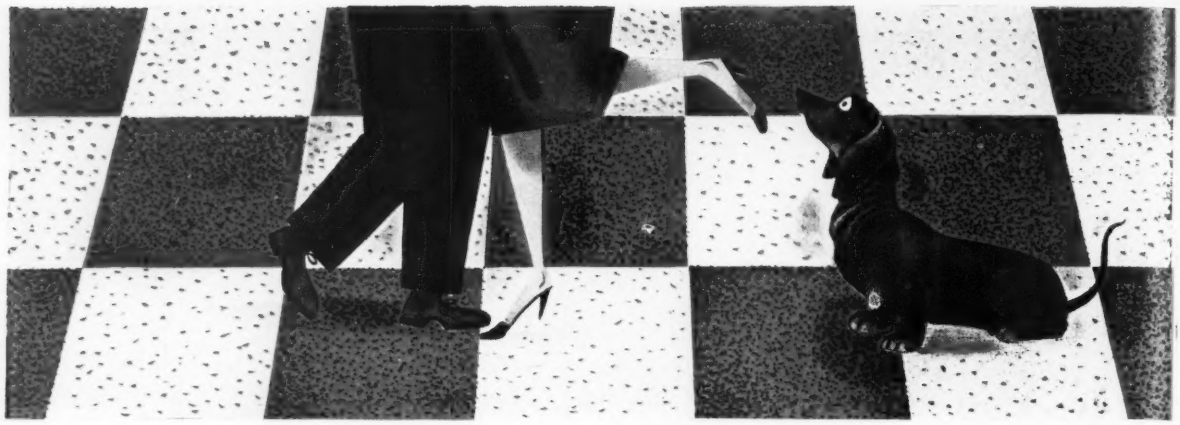

Q. Why does this rubber tile have the light color and elegant pattern consumers want, provide extra wearing qualities at low cost, and make more top quality tile on first run?

A. Because it's made with **VELSICOL HYDROCARBON RESINS!**

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VELSICOL CHEMICAL CORPORATION
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- ☐ Please have a salesman call to discuss Velsicol Hydrocarbon Resins for rubber tile.
- ☐ Please send a sample for pilot plant use.
- ☐ Please send technical literature. RW-49

Name_____

Company_____

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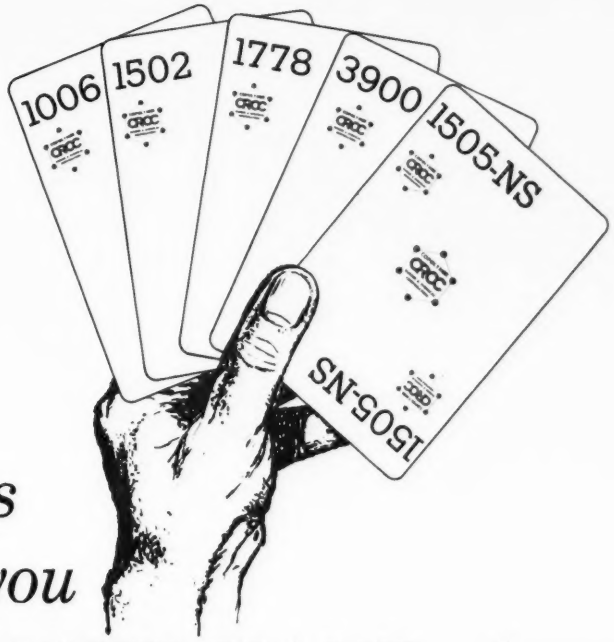

Let us give you the RIGHT HAND – for your

NON-STAINING PRODUCTS

TYPE	DESCRIPTION AND USE
COPO 1006	"Hot", General Purpose Polymer. Used in white sidewalls, floor tile, wringer rolls, etc.
COPO 1502	"Cold", General Purpose Polymer. Used in white sidewalls, floor coverings, shoe soles and heels, etc.
COPO 1778	"Cold", General Purpose Polymer Extended With Highest Grade Non-Staining Oil. Used in products where color stability is demanded at minimum cost.
⬡ COPO 3900	"Cold", Special Purpose Polymer Extended With 25 PHR Highly Purified Wood Rosin. Improves building tack, flex life and compression set. Used in floor tile, shoe soles and heels, appliance and drop cord, molded and extruded mechanical goods.
⬡ COPO 1505-NS	"Cold", Special Purpose Polymer With Low Bound Styrene Content. NOW NON-STAINING. Used in products where low-temperature serviceability is required.

⬡ A COPOLYMER EXCLUSIVE

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MAIN OFFICE:

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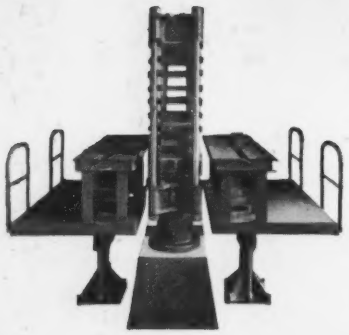


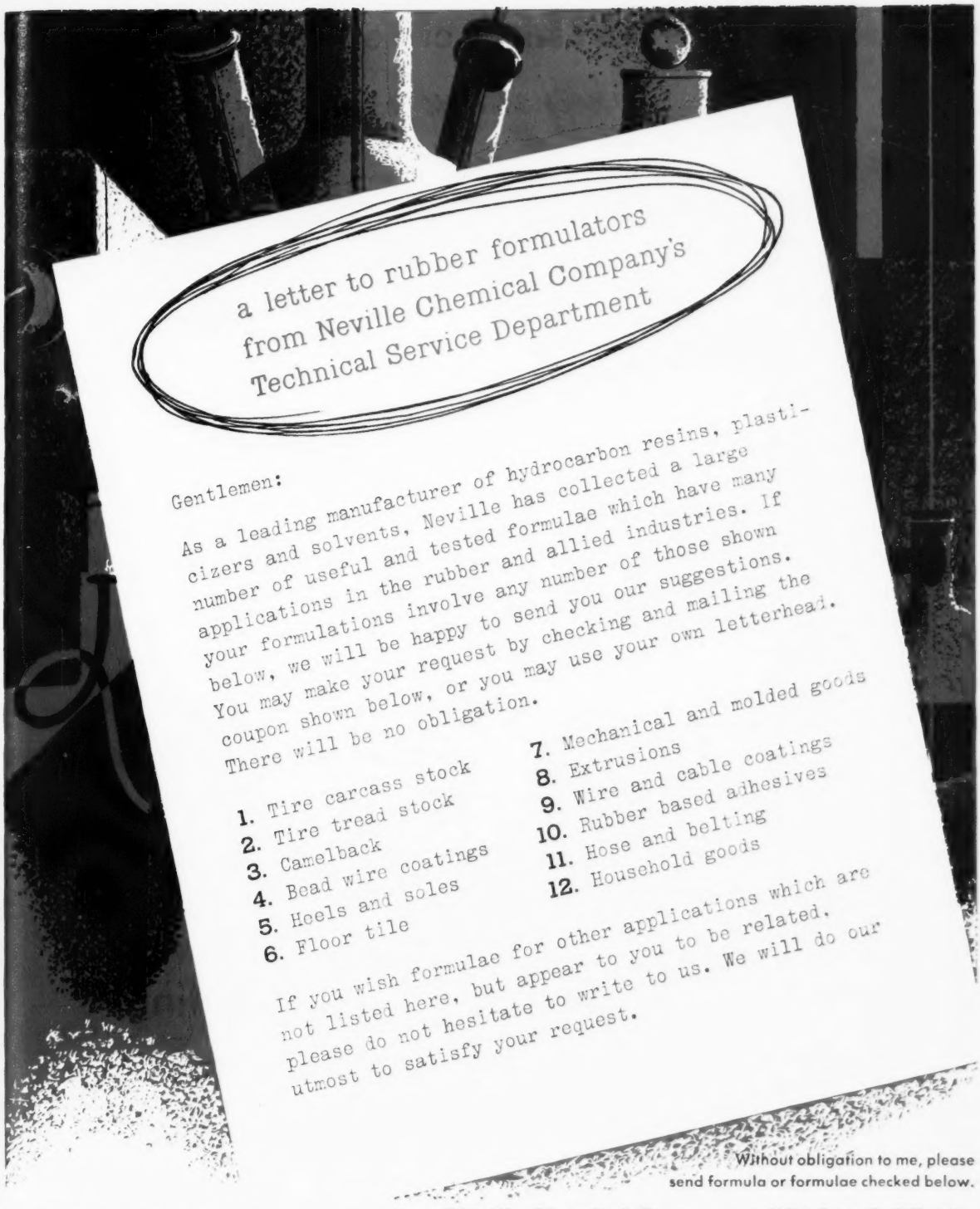
192-ton Multiple Opening Platen Press. Designed for molding rubber products. This press may be operated from an individual self-contained pumping unit or a central accumulator system. Two elevators operate with two presses working side by side. Write for catalog and engineering information on this and other R. D. Wood Hydraulic Presses for the rubber industry—without obligation.

The most productive plants use R. D. Wood Presses

For proof, look at production records—and downtime for maintenance. Then watch an R. D. Wood Press at work. See for yourself the smooth, precise operation—the dependable performance—even under tough conditions. Finally, inspect an R. D. Wood Press up close. Notice the soundness of design, the excellence of materials, the scrupulous care given to each detail of construction. These are the reasons why R. D. Wood Presses have been the standard of excellence throughout the rubber industry.

R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA


a letter to rubber formulators
from Neville Chemical Company's
Technical Service Department
Gentlemen:
As a leading manufacturer of hydrocarbon resins, plasticizers and solvents, Neville has collected a large number of useful and tested formulae which have many applications in the rubber and allied industries. If your formulations involve any number of those shown below, we will be happy to send you our suggestions. You may make your request by checking and mailing the coupon shown below, or you may use your own letterhead. There will be no obligation.
1. Tire carcass stock
2. Tire tread stock
3. Camelback
4. Bead wire coatings
5. Heels and soles
6. Floor tile
7. Mechanical and molded goods
8. Extrusions
9. Wire and cable coatings
10. Rubber based adhesives
11. Hose and belting
12. Household goods
If you wish formulae for other applications which are not listed here, but appear to you to be related, please do not hesitate to write to us. We will do our utmost to satisfy your request.

NEVILLE

Without obligation to me, please send formula or formulae checked below.

Neville Chemical Company · Pittsburgh 25, Pa.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.

Please send necessary sample or samples of Neville products necessary for experimentation. _____

Name _____ Title _____

Company _____

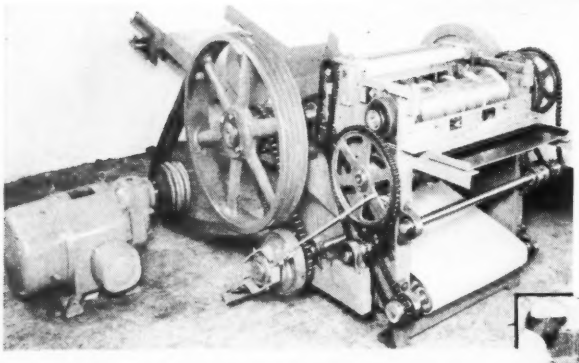
Address _____

NC 34-RW

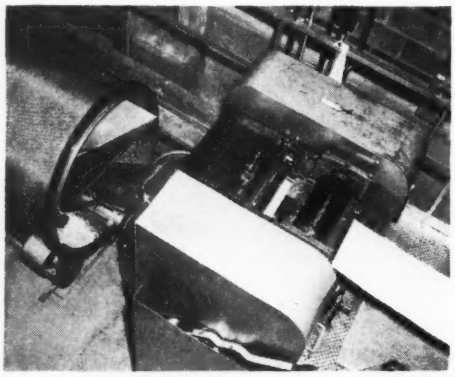
TAYLOR-STILES cutters save you money

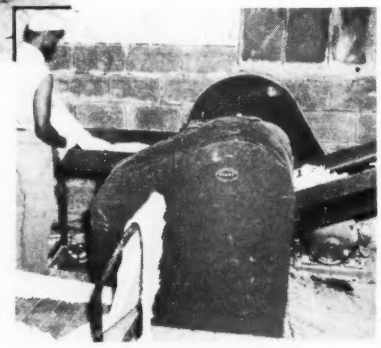
whether you

- **Cut Strips from thin slabs**
- **Pelletize Plastic or rubber sheets or rods**
- **Cut Blanks for Molding**



No matter what your plastic or rubber cutting needs, whether to cut plastic and rubber pellets to exact size, cut thin slabs into narrow strips, or cut blanks to exact size for molding, you will find Taylor-Stiles Cutters save you money. They give greater production (for example, up to 20 tons an hour of plastic pellets), power costs are low, and most users report unusual economy for knife sharpening, and general maintenance.





For full description of these machines, write for folder No's. 216, 213, 202.

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Mildew-proofing *and* Flame-proofing Cotton Fabrics as per Government Specifications. ***Write or Wire for Samples and Quotations.***

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Don't miss the important ACS Rubber Division meeting in California

The Division of Rubber Chemistry of the American Chemical Society will meet in Los Angeles on May 13, 14 and 15. Shell Chemical, the synthetic rubber producer on the West Coast, hopes you will attend.

Here is a wonderful opportunity to meet all your friends in the rubber industry. There'll be firsthand information on everything that's new about rubber. Come and see for yourself the metropolitan area that is one of the largest markets for tires and camelback in the U.S.A. —and growing every day!

In Southern California, Shell Chemical operates the world's only fully integrated plant making general-purpose synthetic rubber. Styrene, butadiene and the widest selection of rubber polymers and latices available from a single source are manufactured in our Torrance plant.

So, put a ring around May 13, 14 and 15 on your calendar—the days we will see you in Los Angeles!

SHELL CHEMICAL CORPORATION

SYNTHETIC RUBBER DIVISION

P. O. Box 216, Torrance, California

SHELL

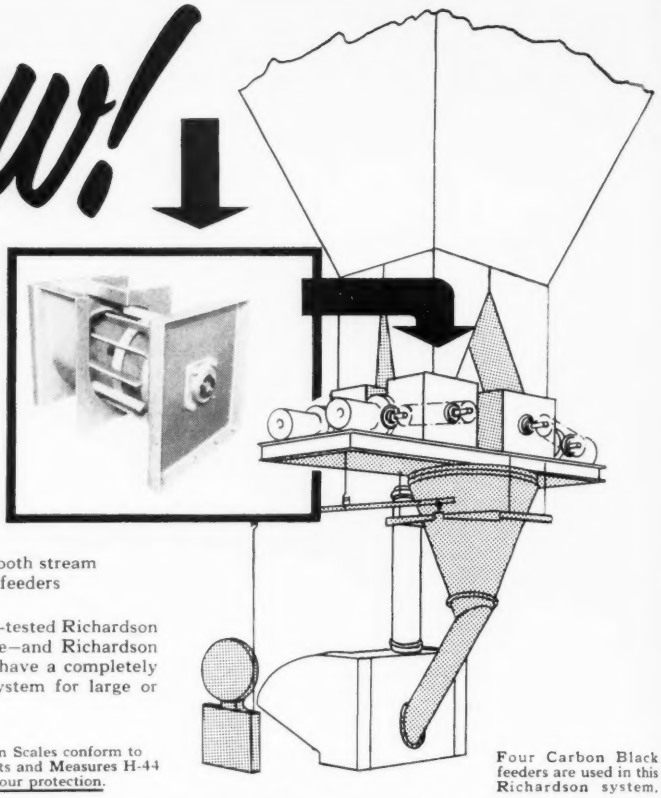
it's new!

Specialized Carbon Black Feeder Increases Weighing Accuracy for Better End Products

Richardson's latest contribution to the production of improved rubber products, at lower manufacturing costs, is this new-type Feeder that eliminates pulsations in delivery of carbon black to the scale. Located in-line with storage bin and scale, it . . .

- delivers at a rate of up to 20 cu. ft. per minute in smooth stream
- provides vastly improved accuracy over other rotary feeders
- allows maximum space economy

Add to this important new development the performance-tested Richardson Carbon Black automatic scale—the most accurate made—and Richardson automatic controls and recording equipment, and you have a completely automatic, efficient, *low cost* carbon black handling system for large or small rubber plants. Write today for full information.



Four Carbon Black feeders are used in this Richardson system.

Richardson Scales conform to U. S. Weights and Measures H-44 for your protection.

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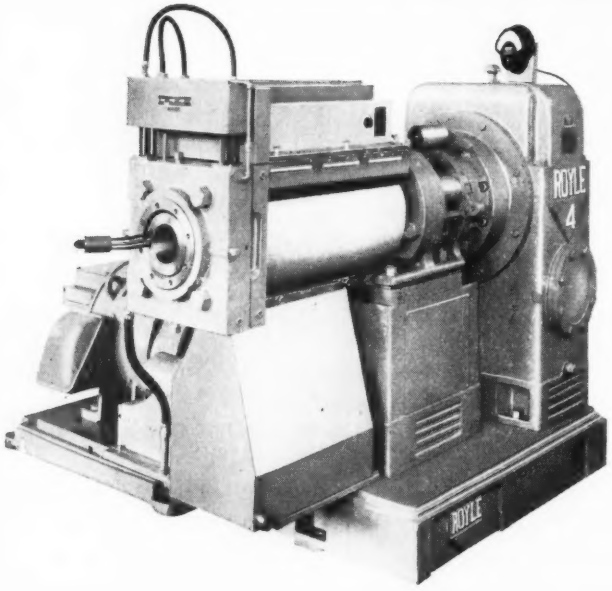
Also manufactured in Europe to U.S. standards



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For Maximum Versatility

Whether you are extruding plastics that require high processing temperatures or quick-curing compounds Royle Spirod —the all purpose, all-electric, completely automatic extruder —provides positive temperature control. This versatility is the result of combining a proportioning controlled system of high velocity evaporative cooling with tubular resistance heating to supply constant, accurately zoned processing temperatures.

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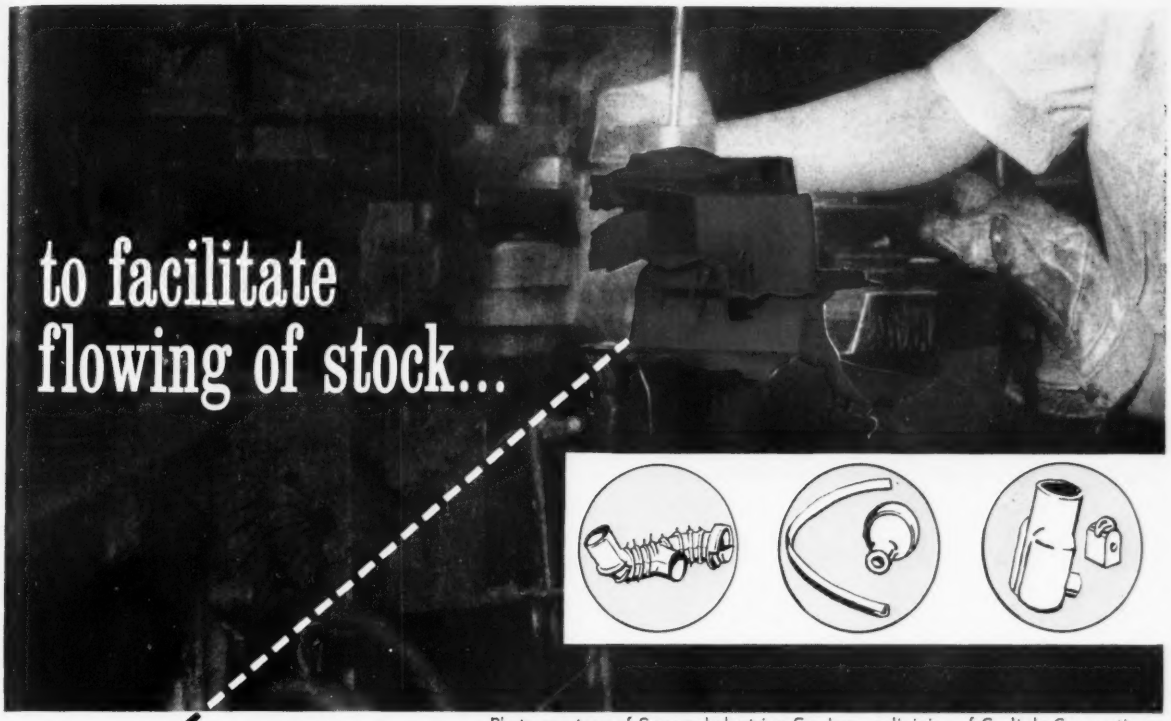
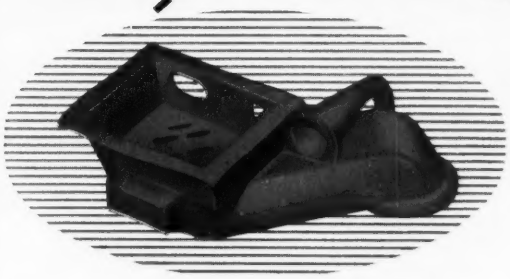


Photo courtesy of Geauga Industries Co. Inc., a division of Carlisle Corporation.



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"Don't miss the Rubber Division Meeting in Los Angeles, May 13, 14, 15th."

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RESINS

In difficult molding jobs like the part for automatic dish-washing machines shown in the photo, Geauga Industries uses PICCO Resins to facilitate the flowing of stock. They have found PICCO Resins the answer to their specific problems in rubber and plastic compounds.

There are as many different PICCO applications as there are compounds. They are commonly used to plasticize, extend, stiffen, reinforce, or tackify rubber and plastics. More specialized uses include modification of latex and dispersion of hard-to-handle chemicals through the compound.

Consult your local Harwick technical representative for information on the PICCO Resin or Resins which will add desirable qualities to your compound at reasonable cost.

PICCO Resins - manufactured by
Pennsylvania Industrial Chemical Corporation.

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Research Underscores Need of New Approach to Manufacture of Hose and Other Rubber Equipment Exposed to High Octane Gasoline

TLARGIANS!!

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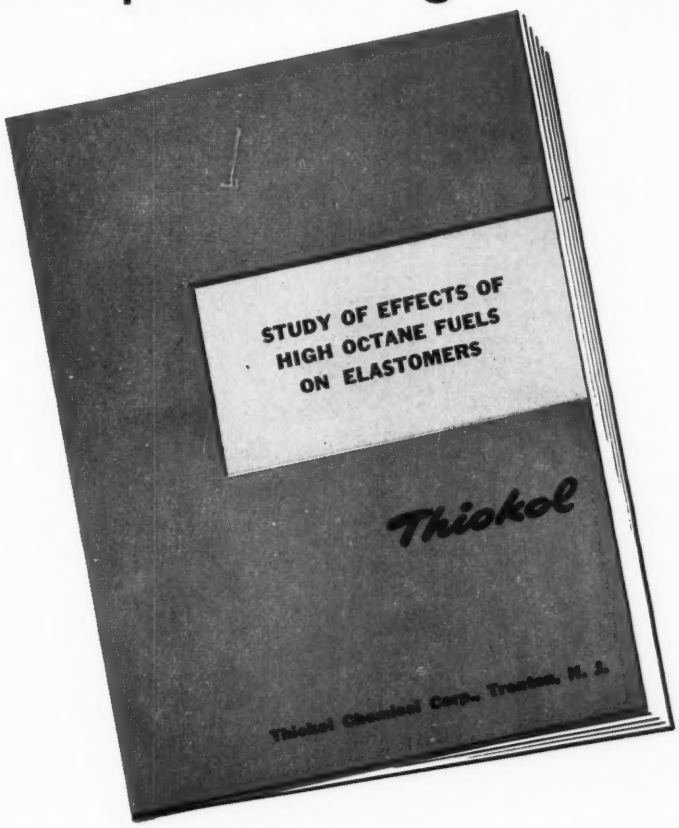
RUBBER DIVISION MEETING
LOS ANGELES
MAY 13, 14, 15



Laboratory study shows dangerous degradation of present elastomers under new aromatic fuels

The trend to higher octane gasolines dictates a re-evaluation of rubber requirements – in the petroleum field – at refinery, transportation and service station levels. Exhaustive tests by THIOKOL point up the need.

Six different types of synthetic rubber now widely used – including THIOKOL ST and FA polysulfide crudes – were used for the tests. Immersed in fuels of varying aromatic content, from 25% to 100%, the elastomers were measured for volume swell, tensile strength, and low temperature properties. Most synthetics showed a marked reduction in physical properties and serviceability, while the THIOKOL crudes satisfactorily resisted "high octane rot."

The detailed results of this THIOKOL study hold great significance for suppliers in the rubber industry. Coupon will bring you a copy of the complete report.

FOR MORE INFORMATION:
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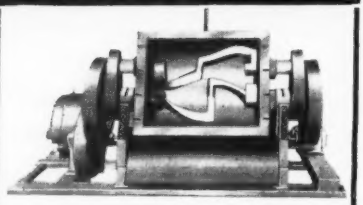
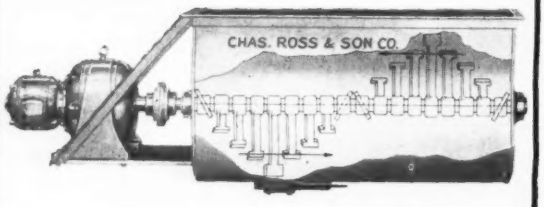
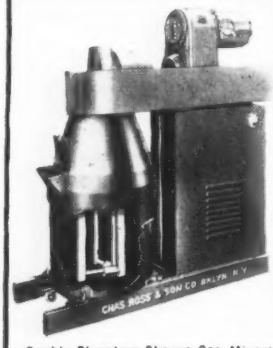
100 - 1000 Gal. sizes



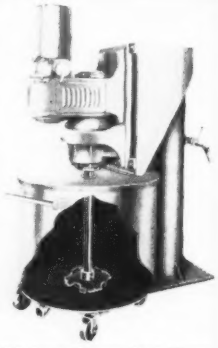
Heavy Duty Double Arm Kneaders
1 pint - 150 Gal. sizes

Rubber Reclaiming Mixers
100 - 1000 Gal. sizes



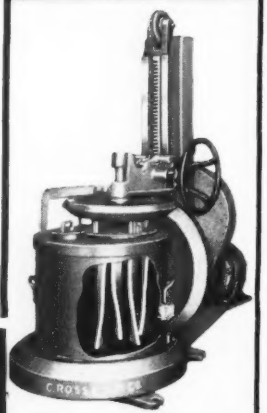


Double Planetary Change Can Mixers
1 - 150 Gal. sizes



High Speed Change Tank-Mixers
80 - 250 Gal. sizes

Heavy Duty Paste Mixers
25-1000 Gal. sizes



Heavy Duty Change Can Mixers
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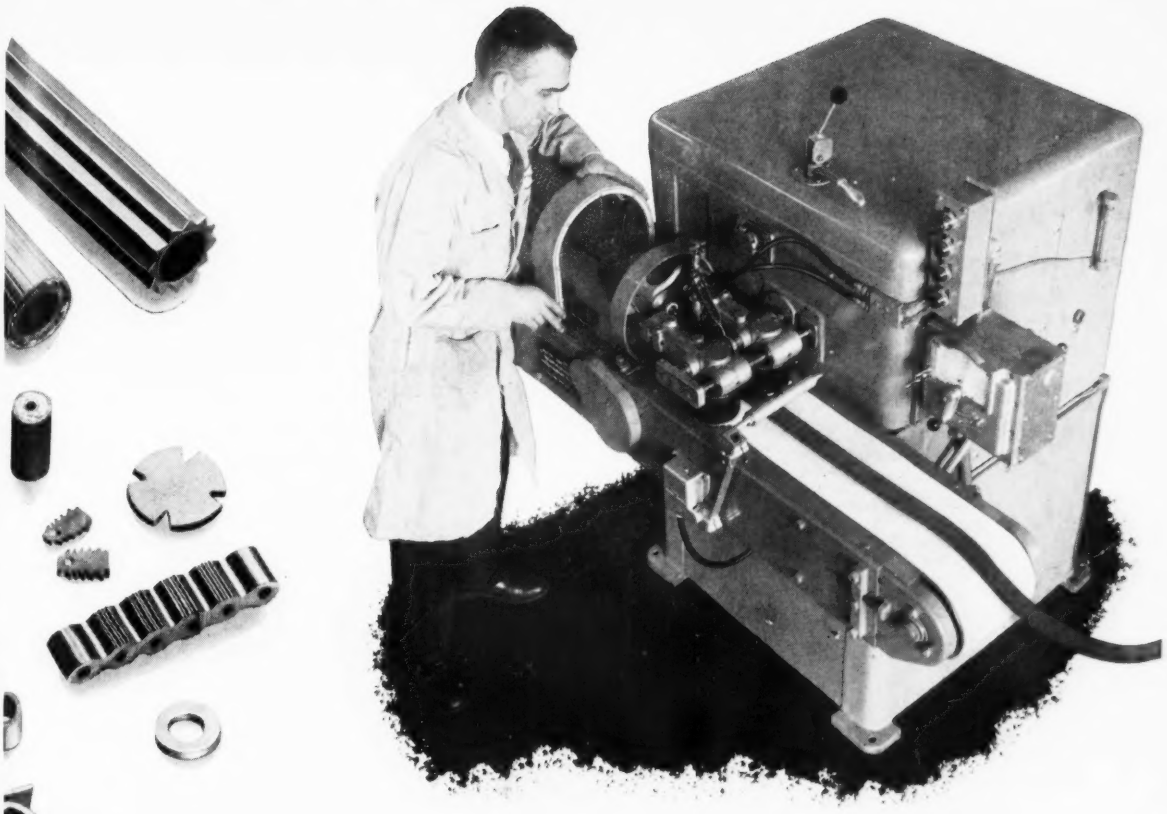

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HOUSEWARES, TOYS, SPORTING GOODS, DRUG SUNDRIES	Non-staining compounds with high degree of transparency • permanent, white or pastel colors • high physicals and low cost.
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Other special polymers for adhesives, can closures, plastic compounding, sealants.	

SYNPOL synthetic rubber is used today by hundreds of the country's most experienced rubber processors... who have found that one or more of the various available grades helps them produce a better product, at low cost.

Offering the widest line of clear polymers in the industry, the latest development in ultra-dispersed black masterbatches, a comprehensive technical service program and an extensive warehouse operation, SYNPOL may well be the answer to *your* product, processing, inventory or delivery problem.

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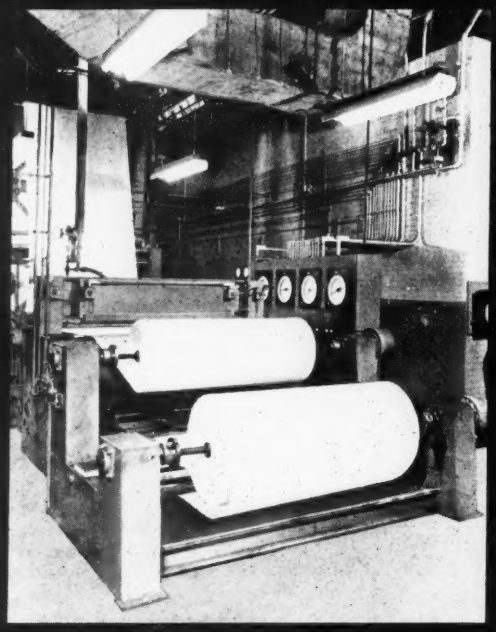

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The problems eliminated by this unique reel-less core packaging system are manifold. Loads are palletized two cores per pallet and may be stacked two or three high. This, plus the fact that you need not accumulate empty reels means storage space requirements are cut to *less than half*. You do away with all freight and handling costs on reels, the bother and expense of "bookkeeping" returnable reels, and the freezing of money in reel deposits.

This is typical of Roebling's advanced packaging methods—that makes handling Roebling high-quality wire so much easier. For details on this efficient Roebling Tire Bead Wire packaging method, or information on other types of Roebling wire, write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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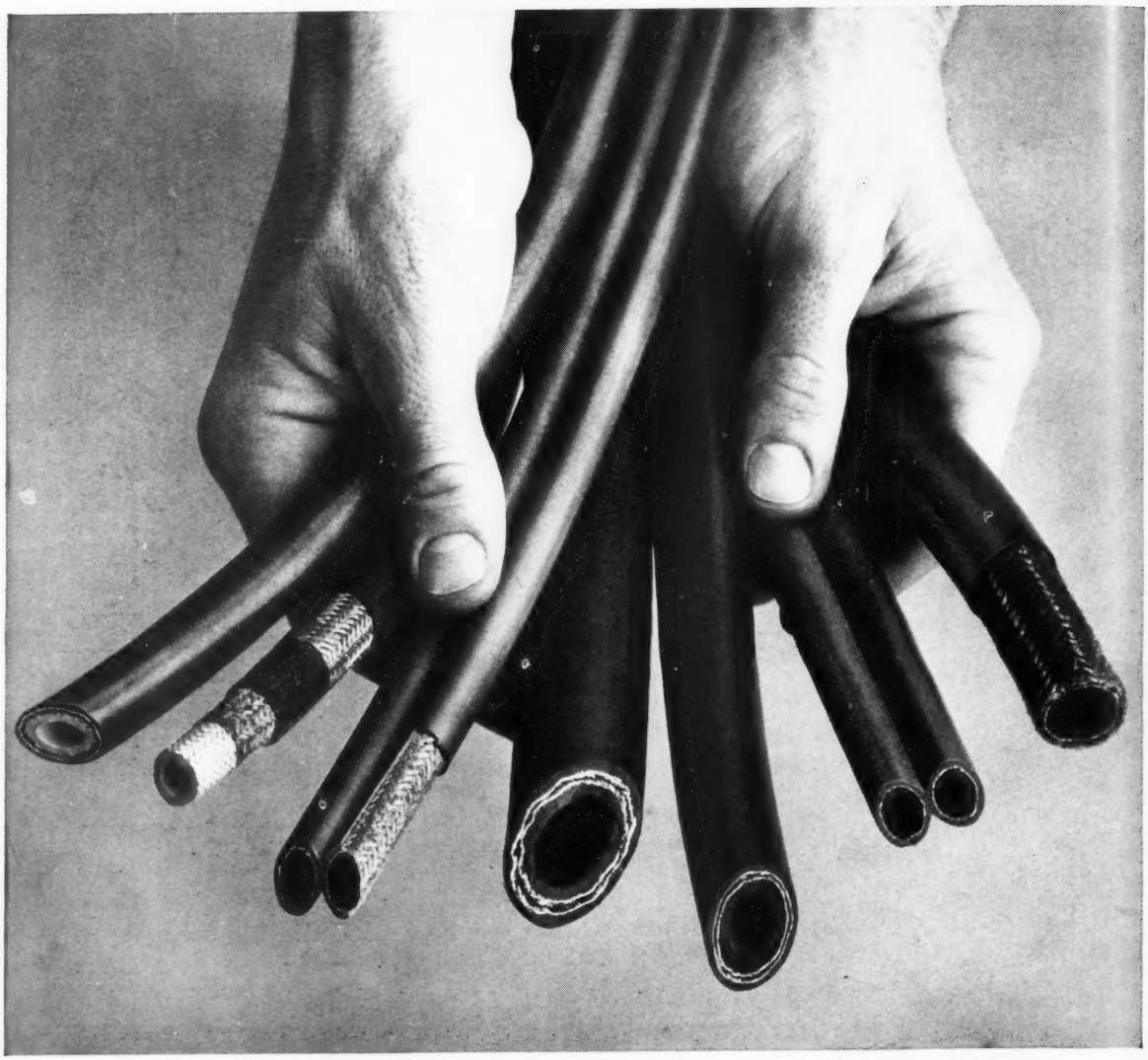

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Braided hose reinforced with strong Celanese FORTISAN-36 gives you a unique combination of low growth and high burst resistance—plus the added advantage of reduced weight. FORTISAN-36 rayon yarn neither shrinks nor stretches under the influence of heat and moisture. This means better quality control during processing and stepped-up performance of the final product. For information on Celanese FORTISAN-36 and its uses in industry, write to: Celanese Corporation of America, Sales Development Dept., Fibers Div., Charlotte, N.C.

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The "Vees" molded into the RIPPLE® Sole must rebound from rough and rugged treatment, since only the limited area of their crowns constitutes the entire walking surface. It's a job of reinforcement tailor-made for our Columbia-Southern Hi-Sil 233, which in Beebe's judgment "just works out better in our compounds than any of the other reinforcers we'd tried."

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Columbia-Southern Chemical Corporation, One Gateway Center, Pittsburgh 22, Pa. Offices in fourteen principal cities. In Canada: Standard Chemical Limited.

RIPPLE® Soles, as displayed on these shoes by (left to right) Cardone & Baker, E. T. Wright, and Buster Brown, are available in red, chocolate, natural, grey, black and white.

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Want to eliminate scorch damage in neoprene processing? Specify MAGLITE D. Tests prove that it offers better scorch protection for neoprene than any other magnesium oxide you can use. MAGLITE D also helps solve storage problems since it occupies about one-third the warehouse space as many of the lightweight magnesias. The benefits of using MAGLITE K, M, or Y for other elastomers and certain product or process requirements are equally impressive. For samples and technical information write to MERCK & CO., INC., Marine Magnesium Division, Department RW-2, Rahway, New Jersey.

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NEW MATERIALS

Henley ZPD Ultra Accelerator

A new ultra accelerator, Henley ZPD, or zinc pentamethylene-dithiocarbamate, has been announced by Henley & Co., Inc., New York, N. Y. It is designed for greater ease in processing by obtaining a wide margin of safety in curing time as well as a more extensive vulcanization plateau and so better modulus and tensile strength.

ZPD does not discolor compounds and consequently can be used with safety in transparent and light-colored stocks, according to Henley. The new material is easily dispersed and ideal for all types of latex which require a water insoluble accelerator. ZPD also has little or no thickening effect on stored compounded latices and gives fast cures and good aging stocks.

Some typical properties have been reported as follows:

Color	white
Odor	none
Physical state	powder
Storage stability	excellent
Melting point	437–446° F.
Specific gravity	1.55
Water solubility	0.3 max.

Henley can provide samples and further technical information upon request.

Chemigum N600

Chemigum N600, a medium-acrylonitrile-content rubber produced by low-temperature polymerization, is now available from the chemical division, The Goodyear Tire & Rubber Co., Akron, O. This rubber is stabilized with a non-staining, non-discoloring antioxidant, permitting its use in all medium-nitrile-content products requiring good color characteristics.

Chemigum N600 incorporates the better physicals and easy-processing characteristics of low-temperature polymerized rubbers while retaining the outstanding molding properties of low Mooney viscosity elastomers such as Chemigum N6. In addition, N600 exhibits vastly improved scorch resistance in comparison with medium-nitrile-content polymers, according to Goodyear.

Chemigum N600 possesses excellent oil, fuel, and grease resistance and is particularly outstanding in resistance to water swell, it is reported. While N600 may be slightly slower in curing than hot N-type rubbers, a small addition of activating accelerator will easily bring cure times into line.

Some typical physical properties of Chemigum N600 are:

Approximate acrylonitrile content, %	32
Specific gravity	0.98
Mooney viscosity, ML 212° F./4 min.	53
Solubility in MEK, %	95
Ash content, %	0.40
Antioxidant	non-staining non-discoloring
Color	beige
Odor	mild-pleasant
Storage stability	excellent

A Tech-Book Fact bulletin, CG-40, covering test vulcanizate recipe and physical properties of test vulcanizate is available from the company.

MORE TIRE POWER means LESS TREAD WEAR

START WITH AN OVERLOAD

The illustration above shows a 100% load. In an independent test, trucks equipped with nylon tires and tires containing TYREX viscose cord started with *120%* loads . and went up from there!

ADD INTENSE HEAT

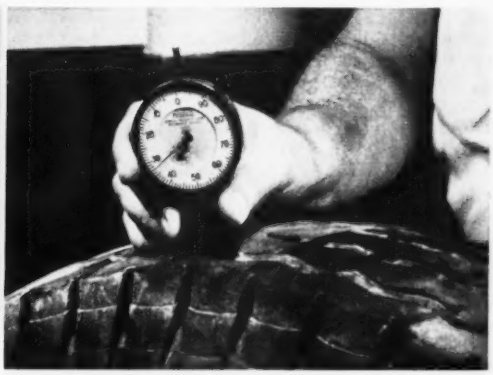
Tire and roadbed temperatures were checked carefully. Although road temperatures soared to 139°, tires made with TYREX viscose cord more than adequately met these adverse temperature conditions.

THEN PILE ON MORE WEIGHT

Tires containing TYREX viscose tire cord traveled over 20,000 miles at up to 40% overloads without any failures. Then the overload was upped to 50% above Tire and Rim Standards.

SOME CAN'T TAKE IT

Before the test ended some tires had failed from separation . . . could not be used or recapped. Tires containing TYREX viscose cord went on to *30,000* miles . . . *had* tread left and *were* recappable.



. . . BUT TYREX CAN AND DID!

When the testing was completed, measurements of all the tires showed: the rate of tread wear of *10 ply* tires made with TYREX viscose tire cord was up to 21.7% better than *12 ply* nylon tires.

TYREX*

TIRES MADE WITH TYREX VISCOSE TIRE CORD DELIVER UP TO 21.7% BETTER TREAD WEAR

Give your customers more tire power with TYREX viscose tire cord—the tough new cord that makes *any* tire run cooler, softer, quieter and safer . . . without flat spotting. These advantages make selling a lot easier.

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**TYREX is a certification mark of Tyrex Inc., for viscose tire cord and yarn. TYREX viscose tire cord and yarn are also produced and available in Canada.*

New Materials

New Protovac Caseins

Four new Protovac cold-water soluble caseins, PV-424, PV-428, PV-430, and PV-800, have been announced by the Borden Chemical Co., New York, N. Y. These new caseins required only 10 minutes of alkali soaking and about 30 minutes of mixing at only 60-80° F. for dissolving. The caseins were designed for use in paper coatings, paints, inks, adhesives, leather and textile finishing, wax and asphalt emulsions, and as latex stabilizers and thickeners.

Protovac PV-424 is designed for easy dissolving in plants having no cooking facilities. It is particularly useful as a latex stabilizer, adhesive, grease-proof coating, pigment dispersant, and thickener. It is a fine-mesh casein, has a very low ash content and free acid content, low bacteria count, low alkali requirements, and high adhesive strength.

Protovac Casein PV-428 is a sodium caseinate with low foaming properties and soluble in cold water at low pH without the addition of alkali. It is unique in that resulting solutions are of low pH at only 6.0. This low degree of alkalinity makes it particularly useful as an adhesive for metallic pigments. It also may be used as a latex stabilizer and pigment dispersant where low pH is required.

Protovac PV-430 is a low-foaming zinc casein, soluble in cold water with the addition of ammonium hydroxide, producing water-resistant films. It is designed for use where water-resistant casein films are required, particularly in paints, paper coatings, inks, textile finishes, and wax emulsions. Solutions of PV-430 have high viscosity, and small amounts give considerable thickening when added to styrene-butadiene latex.

Protovac PV-800 is a biologically stable, low-foaming casein with low viscosity, soluble in cold water with the addition of alkali. It is designed for use where a casein solution of low viscosity and resistance to spoilage is required; it is particularly suggested as a pigment dispersant, a latex or asphalt stabilizer, an emulsifying agent, or a wax modifier. It may also be used in paper coatings, inks, paints, leather finishes, and as an adhesive.

Some physical properties of these Protovac caseins are:

	PV-424	PV-428	PV-430	PV-800
State	dry granular	dry granular	dry granular	dry granular
Fineness	98% through 80 mesh		98% through 80 mesh	
Color	light cream	light cream	white	light yellow
Solvent	water, with alkali	water	water, with NH_4OH	water, with alkali
pH	—	5.8–6.2	9.2	8.5

Technical bulletins giving more detailed information and instructions for use are available from the company.

New Rubtex Binder

A new liquid rubber binder, which makes it possible to turn waste foam rubber and polyurethane scraps into new sheets or molded foam rubber articles, is available from Rubba, Inc., New York 60, N. Y. This unique liquid polymer, designated Rubtex, will bond both similar and mixed scrap, whether derived from natural or synthetic rubber, as well as scrap vinyl foam.

Rubtex may be used to blend polyether urethane foam into usable slabs; to blend vinyl foam scrap with both polyurethane scrap foam and natural rubber scrap; and to make flexible cork sheets by mixing Rubtex with cork granules. Leather dust and chips can also be blended with Rubtex to produce a leather-like material, and wood flour can be combined with Rubtex to produce a lower-cost bonded foam. These bonded materials can be used in the manufacture of upholstery, mattresses, pillows, shoes, toys, displays, and many other products.

Rubtex is available in all-size containers, ranging from pints to 55-gallon drums. Rubtex is reported to be non-inflammable, self-vulcanizing, heat-resistant, and odorless.

A brochure, describing the bonding of scrap foam with Rubtex, is available from the company.

SCO Release Agents

A new release agent, designated SCO #35-Release Agent, which is said to be outstanding for its versatility in rubber and plastic processing, has been announced by Ernest C. Schmidt Co., Ho-Ho-Kus, N. J. It is useful throughout the plant as a processing aid for molding of parts and in general as an anti-sticking agent. For mold release operations, it gives easy troubleless release while improving the finish of molded parts. For stock release it permits easy handling of cured and uncured rubber compounds of natural, synthetic, and reclaimed stocks.

SCO #35 is also suggested for application on paper and textile liners and for use in impression molding involving textiles, wire mesh, hose wrapping, etc. It can be applied by spraying, dipping, or spreading, depending upon dilutions used and facilities at hand.

Other SCO release agents are available for solving problems encountered in extruding and calendering rubber and plastic products. Several types are suggested: SCO-40-XC, which adds slip; SCO-86-XG, a surfactant; SCO-88-A, a wax type; and SCO-80-SC, which also adds slip. These can be used individually or blended with one or the other as required.

Some other SCO products include: SCO-GSR, a release agent for natural-synthetic-reclaimed rubber compounds; SCO M-X-R, a release agent for molds or liners; and SCO-75-PA, a useful dispersion where zinc stearate is indicated. SCO-PL is a compounding aid for natural, synthetic, and reclaim compounds which, when incorporated therein, acts as an internal lubricant. SCO-PS is an emulsion-industrial lubricant for natural or synthetic rubber latex compounding.

Additional information on the products mentioned above can be obtained from the manufacturer.

New Neoprene Latex

A new neoprene latex, designated Type 400, has been introduced by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. The new latex is claimed to yield products with more than twice the heat resistance, three times the wear strength, and 15 times the ozone resistance possible with previous neoprene latices.

Neoprene latex Type 400 shows particular promise as a binder for natural and synthetic fibers. The tendency to tender or discolor cellulosic materials is said to be greatly reduced. Adhesives prepared from it have good water resistance and excellent cohesive strength at high temperatures, according to Du Pont.

As a blending agent with other types of neoprene, Type 400 can be used to raise modulus or upgrade ozone resistance. Its unusual resistance to oil, heat, and ozone makes Type 400 interesting for automotive and industrial dipped goods or for an overdip on such products.

Films made from Type 400 latex are strong and tough after simple drying. Acceleration and cure may be used to realize even greater physical properties. As with other neoprene latices, an antioxidant and zinc oxide are used with Type 400 to improve aging. Films of Type 400 have good resistance to aliphatic oils and solvents at both room and elevated temperatures, it is further claimed. The electrical properties of these films approach those of natural rubber.

Neoprene latex Type 400 is an aqueous, colloidal suspension of a high modulus polymer. The latex is anionic and is said to be extremely stable toward natural shelf and heat aging.

Some typical physical properties of Type 400 are reported as follows:

Solids content, %	50
Specific gravity @ 77° F.,	
Latex	1.15
Dry Polmer	1.42
pH	12.5
pH Decline @ 194° F.	none after 10 days
Color	white
Stability toward storage	excellent
Mechanical stability	excellent
Stability toward compounding	excellent

brother, that's for me!

New AMERIPOL MICRO-BLACK banishes black mess, boosts mixer output 25% or more

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You get superior carbon black dispersion and therefore greater abrasion resistance in your finished rubber products when you use Ameripol Micro-Black. For Goodrich-Gulf has achieved the ultimate in carbon dispersal with high liquid shear agitation at the latex stage.

New data book—For full information on the complete line of Ameripol Micro-Black masterbatches—and samples—write Goodrich-Gulf Chemicals, Inc., 3121 Euclid Avenue, Cleveland 15, Ohio.

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TECHNICAL BOOKS

BOOK REVIEWS

"The Effects of Ionizing Radiation on Natural and Synthetic High Polymers." By Frank A. Bovey. Polymer Reviews, Volume I. Cloth, 6 3/16 by 9 1/4 inches, 287 pages. Interscience Publishers, Inc., New York, N. Y., 1958. Price, $8.00.

This timely volume is a critical review of the principles and results which have appeared in the rapidly developing field of radiation chemistry of polymers. It contains, in addition, background information on related topics. Thus the first chapter gives brief descriptions of the general properties of ionizing radiations and how they interact with matter, sources of radiation, methods of measurement and detection, and units. But the treatment of these subjects is very sketchy and rather inadequate for most purposes beyond an introduction for those unfamiliar with them. The chapter on the types of chemical effects produced by ionizing radiation, or what is usually called radiation chemistry, is also introductory and seems to serve mostly as preparation for the more detailed development of the subject later in connection with the radiation chemistry of polymers.

The radiation chemistry of polymers, on the other hand, is presented concisely, but with good detail and with many references. The emphasis on basic research is evident in the exposition of the general theory and statistical treatment of cross-linking and scission. These principles are applicable to any random scission and cross-linking processes, but are especially pertinent for interpreting the effects of radiation on the structure of polymer molecules. The cases of random scission with and without cross-linking and *vice versa* are analyzed as well as the occurrence of branching, gel formation, and endlinking.

The rather voluminous experimental investigations on the effects of radiation on polymers are organized and reviewed by grouping the polymers in the following way: hydrocarbon polymers, acrylate and methacrylate polymers, chloro and fluoro polymers, diolefin polymers, condensation polymers, and natural polymers and derivatives. Each of these chapters contains a number of sub-classifications, and the most important types of elastomers receive attention under one or another of these classifications where they are listed according to composition.

Although the discussion of the radiation effects is purposely concentrated on results which appear to have fundamental significance, references to technological studies are also very numerous. The comparisons and interpretations of the results from independent investigations on the same type of polymer lead, in many cases, to a considerable enhancement of the understanding of the results and a useful picture of the status of ignorance and knowledge for a particular subject.

The book is well arranged. A list of references is at the end of each chapter. In addition to an appendix with a tabular presentation of the radiation sensitivity and principal effects of radiation on about fifty important polymers, there are a glossary of symbols and an author and subject index.

The author has performed a notable service for the development of the radiation chemistry of polymers and to research workers in the field of radiation effects by bringing all of this material on polymers together in such an excellent way. In addition, the book will be a useful reference volume in connection with almost any conceivable interest in the field of radiation effects on polymers.

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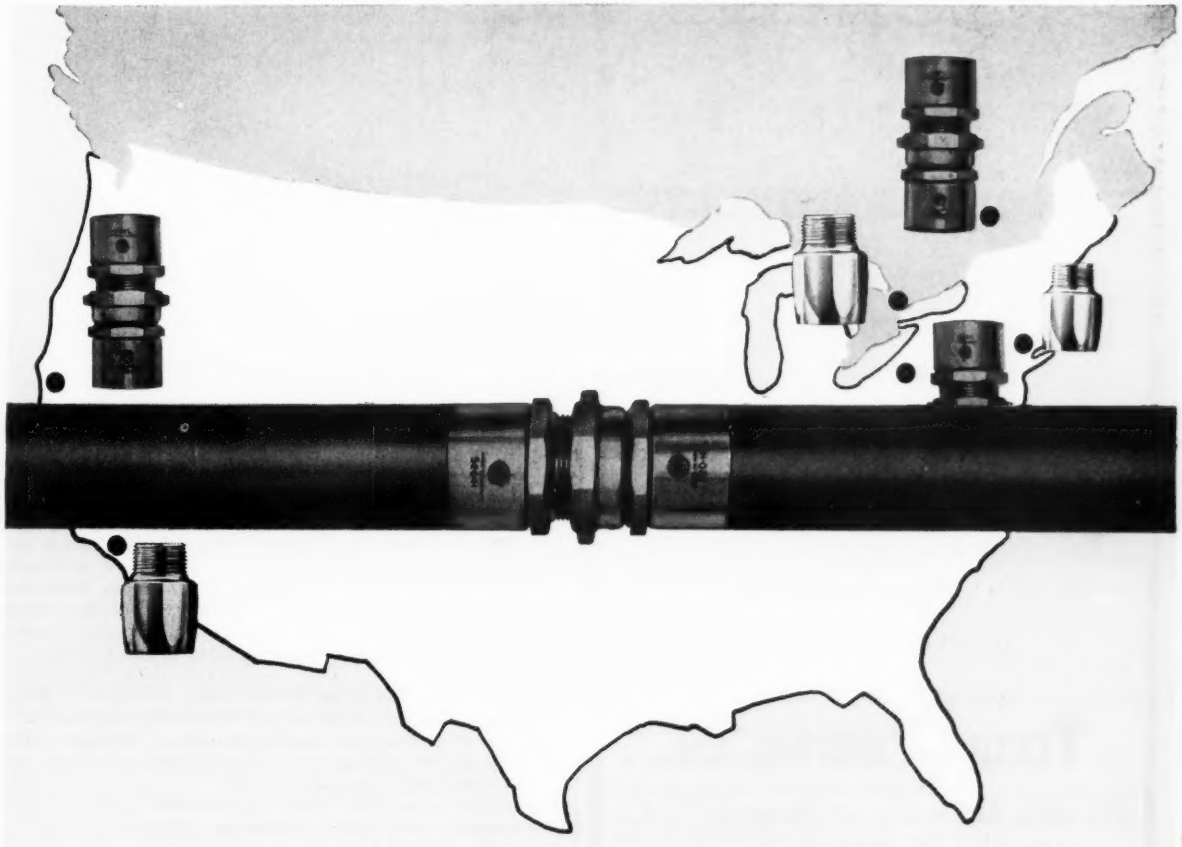

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Technical Books

"Management for Engineers." By Roger C. Heimer. Cloth, 6¼ by 9⅜ inches, 453 pages. McGraw-Hill Book Co., New York, N. Y., 1958. Price $6.75.

This book has as its purpose the introduction of general day-by-day workings of a business firm to the young engineer. About 40% of all engineers eventually become managers, and almost all engineers are close enough to management that they need to know how management processes work. The engineer is trained to look at things objectively and to use facts in making his decision. Management people, on the other hand, make decisions which are subjective. While they may use charts and forecasts, the decisions management makes deals with human beings and not with things and substances; therefore the decisions are much more inaccurate then engineering results.

This book gives the young engineer the necessary understanding of business practices to satisfy the four requirements that industry imposes: namely, that they (1) be acquainted with costs of the many factors entering into production, and with the control of these costs in relation to profits; (2) be aware of basic financial transactions of business, together with an understanding of the sources of and payments for funds for the enterprise; (3) understand the formal organizational structure and the concepts of authority, responsibility, and the coordination of activities and communications, and (4) be aware of the duty of the engineer-manager to contribute to the higher-level decisions in the company.

Even for engineers who may not classify themselves as young starting engineers the book would aid very much in helping bridge the gap between engineer and manager, with a resulting gain in appreciation for each other's problems. The book can be used as an excellent textbook for careful study and will also serve well as a ready reference later.

NEW PUBLICATIONS

Publications of the elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.:

"Low Cost Neoprene Type WHV Compounds with High Clay Loadings." By O. L. Simmons. BL-350. 8 pages. Neoprene Type WHV can be processed with unusually high amounts of clay filler. The vulcanizates possess desirable physical properties, as shown in this report, are competitive with many natural rubber, SBR, and reclaimed rubber compositions, yet offer the added advantages of neoprene's inherent oil, chemical, and weathering resistance. Tables giving formulations and vulcanizate characteristics are included.

"Rigid Neoprene Compositions." By M. A. Schoenbeck. BL-351. 5 pages. Rigid and semi-rigid products can be made using Neoprene Type FB, a semi-fluid polymer. Such products have excellent impact resistance as well as neoprene's well-known resistance to heat, oils, chemicals, and weathering. Filter-press gaskets and appliance handles are examples of the articles which can be made from Type FB. Physical properties, formulations, and vulcanizate data are included in this bulletin.

"Dabco." No. 3. Houdry Process Corp., Philadelphia, Pa. 20 pages. This technical bulletin on Dabco (triethylenediamine), a one-shot polyether catalyst for producing urethane foams, describes flexible-machine made, flexible-hand mixed, and rigid one-shot polyethers using Dabco. The bulletin points out foam formulation, foam preparation, and machine conditions, foam characteristics, and physical properties. Polyether prepolymers and dimer acid ester foams are also covered.

"Monomer Notes." American Cyanamid Co., New York, N. Y. 2 pages. This data sheet is a successor to the four-page bimonthly *Petrochemlines*. It is easier to review and technically informative. Included is information on acrylonitrile and five references.

(*Continued on page 60*)

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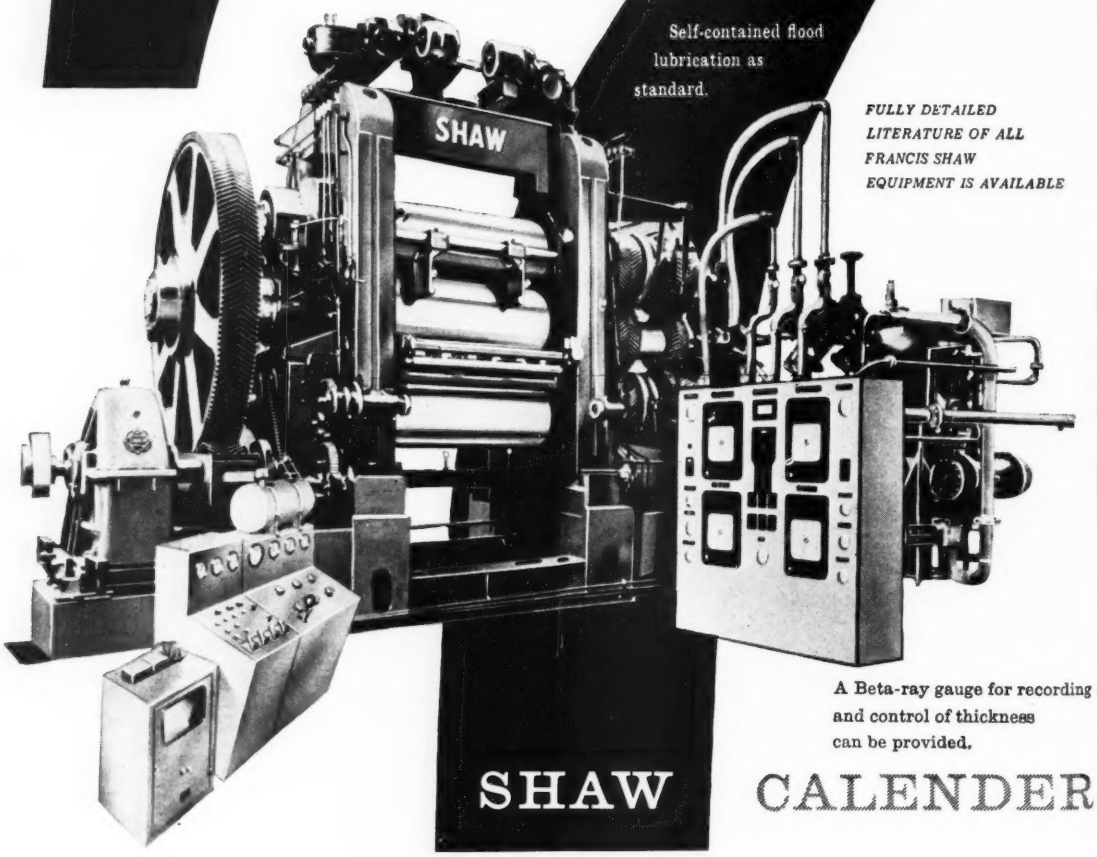

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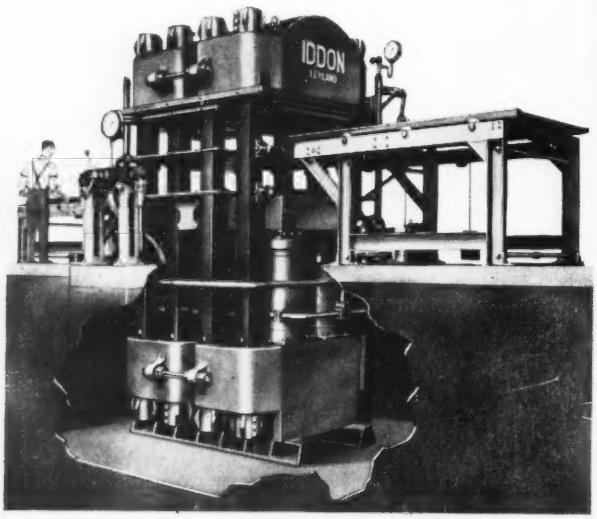

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Technical Books

(Continued from page 56)

"Catalin Antioxidants." Catalin Corp. of America, New York, N. Y. 12 pages. A discussion of the oxidation mechanism through the free radical action introduces this booklet. Following are detailed descriptions of the firm's antioxidant chemicals and their applications in gasoline and jet fuels, petroleum oils, rubber, plastics, and other products. Fully documented laboratory data are provided on physical and chemical properties as well as effectiveness of the antioxidants.

"Cellular Rubber and Plastics." B. F. Goodrich Co., Shelton, Conn. 8 pages. This new literature gives the description, general uses, and physical properties of sponge rubber, neoprene, silicone sponge, Cell-Tite (an expanded closed-cell rubber similar in appearance to sponge), and cellular vinyl. The materials are available in sheet stock, die-cut shapes, pad stock, strips, tubing, cord and molded forms for applications in sealing, vibration damping, shock absorption, insulation, and flotations.

"Stan-Tone GPE Colors." #02-134-4-1-59. Harwick Standard Chemical Co., Akron, O. 2 pages. This revised data sheet lists the GPE colors, manufactured by Sinclair & Valentine Co., which consist of a coloring pigment completely dispersed in low molecular weight polyethylene. The colors listed include white, yellow, orange, red, blue, green, aluminum, and black. They are said to be compatible with polyethylene, rubber and vinyl compounds.

"Plastisol Compound for Roto-Casting Applications." Tech-Book Facts 58-332. Chemical Division, The Goodyear Tire & Rubber Co., Akron, O. 4 pages. Rotational molding is currently being used to produce such hollow items as toys, play balls, novelties, and squeeze bottles. Plastisols for roto-casting are prepared by blending PVC resins exhibiting different properties which are covered in this bulletin. Goodyear PVC resins especially suited for such blends are Pliovic AO, VO, and S50. Three formulations based on Pliovic resin blends are included.

Publications of Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.:

"Paracril OZO Black Extrusion Compounds of 30 to 80 Shore A Hardness." By I. E. Cutting. No. 230. 4 pages. Paracril OZO, an ozone resistant polymer, is recommended for use in automotive and other mechanical goods, both molded and extruded. It imparts excellent oil, fuel, and abrasion resistance. Formulas have been developed using Paracril OZO having a range in Shore A hardness from 30 to 80 inclusive. The formulas, costs, and complete laboratory data are included.

"Paracril OZO Compounds for Aeronautical Materials Specification." By C. M. Churchill and I. E. Cutting. No. 231. 4 pages. The series of Paracril OZO compounds presented is designed to meet the AMS specifications calling, at present, for chloroprene rubber. Paracril OZO compounds meet these specifications and, in addition, swell less in ASTM Oil #3 than chloroprene compounds.

Publications of the Thiokol Chemical Corp., Trenton, N. J.:

"A Study of Butyl Rubber's Resistance to Fire Resistant Hydraulic Fluids." Bulletin 102-1. 8 pages. The purpose of this study was to evaluate the effect of commercial fire resistant fluids at various temperatures on the volume swell and physical properties of butyl rubber compounds. An introduction, test procedure data, materials-used table, conclusions, and results are presented.

"Rigithane 112." Bulletins R-112-1, R-112-2, R-112-3. 11 pages. This is actually a folder containing three bulletins on the firm's Rigithane 112 urethane foaming resin. Included are: (1) a descriptive introduction to Rigithane 112; (2) types and names of available mold release agents for use with this resin; (3) properties of catalysts for use with the resin, together with their effects on foam density and properties; and (4) a new numbering system for the catalysts.

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NEWS of the RUBBER WORLD

Shell Chemical Co. has announced the commercial availability of synthetic polyisoprene at 30¢ a pound, and, at the same time, U. S. Rubber Co. has announced that it is using Shell Isoprene Rubber for the commercial production of 7.50-20 truck tires.

The Rubber Manufacturers Association and 10 rubber belting manufacturers were indicted by a Federal grand jury in March for allegedly violating the Sherman Anti-Trust Act by illegally fixing prices for flat rubber belting. Formal arraignment on the charges was made in the Southern District Federal Court in New York City on March 20.

Several rubber and chemical companies will participate in the American National Exhibition in Moscow this summer. Goodrich, Goodyear, Firestone, U. S. Rubber, and General Tire will have exhibits in Moscow's Sokolniki Park under the management of the U. S. State Department and the U. S. Information Service.

Tyrex, Inc., representing several tire cord manufacturers, claims passenger-car tread mileage 24% greater and truck tire mileage 22% greater for its Tyrex viscose cord than for comparable tires made with nylon cord, based on road tests recently made in Nevada and South Texas.

The rubber industry continues its fight against the S-11 "good faith bill" and other legislation considered to be detrimental to industry progress, through the RMA's recently formed Public Affairs Committee.

Two of the rubber industry's "grand old men," P. W. Litchfield, former chairman of the board of Goodyear, and A. L. Viles, former president of the RMA, passed away in March.

The United Rubber Workers union took the National Labor Relations Board to court on March 9 in an effort to have set aside the NLRB ruling on the three-year-old strike at O'Sullivan Rubber Corp. in Winchester, Va.

Maggie's DCIsion:

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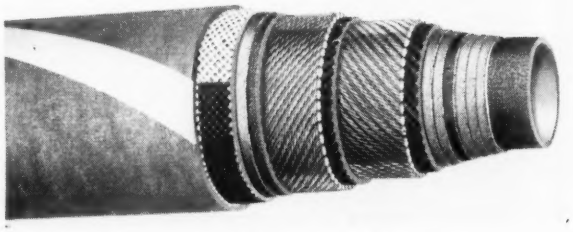

Cutaway of BFG's Super Highflex Hose

New Super Highflex Hose

A new rotary drilling hose, said to be the most flexible drilling hose ever designed for deep drilling has been announced by B. F. Goodrich Industrial Products Co., Akron, O. In its construction, more than two miles of cable, made from 41 miles of high-tensile strength wire, are spiraled inside every 60-foot length of the Super Highflex hose.

Two plies of the extra-heavy wire furnish strength needed to withstand extreme bottom hole pressures. Seven plies of fabric add additional strength. Resilient construction results in a crush-resistant hose that recovers immediately from the effects of sudden shock or impact. This construction is also available in vibrator hose for conducting mud from mud pump to rig.

Hose ends are enlarged to accommodate couplings of the same inside diameter as the hose. Ends are further reinforced with additional plies of wire and fabric to protect against bending stress at the couplings. Couplings are built-in and do not move out of position even under the most severe operating conditions.

The cover of the Super Highflex hose is thick, tough black rubber which resists abrasion, sun-checking, weathering, and scuffing, it is further claimed. The tube is oilproof, with excellent abrasion resistance, and is ⅛-inch thick. Maximum length of the hose is 60 feet. It comes in two inner diameter sizes: 3.0 and 3.5/inches.

A technical bulletin, 3720, gives detailed information on this and other of the company's hose.

New All Traction Tire

A combination highway and traction tire is now available for use by rural haulers and local truck operators fom The Firestone Tire & Rubber Co., Akron, O. The tire is in the low-price range and is called the All Traction.

Designed primarily for rural trucks and local truck operators, the tire is ideally suited for oil, lumber, farm, coal, ready-mixed concrete and construction trucking operations. Extra tread depth, from 48 to 65% greater than for regular highway tires, depending on size, is the main feature of the All Traction, according to Firestone.

Three continuous ribs circle the center of the tire to give it important high-speed, vibration-free characteristics. Deep traction bars on the shoulder of the tire provide the necessary bite for off-the-highway operations.

Rubber-X, a special long-wearing tread compound, is used in the tread of this new tire. Available sizes are the 7.50-20, 8.25-20, 9.00-20, and 10.00-20. The All Traction is a tubed tire.

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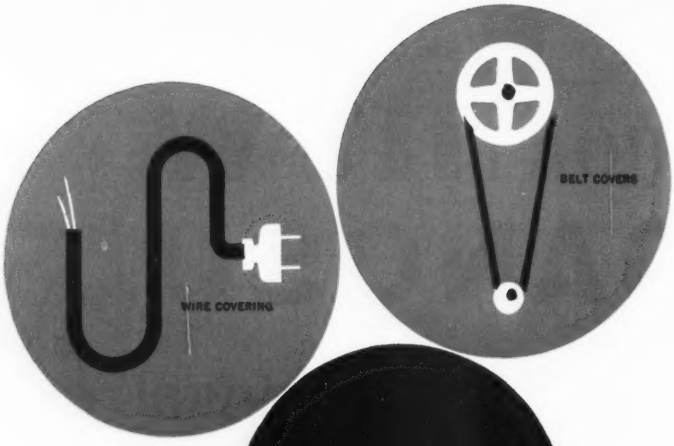

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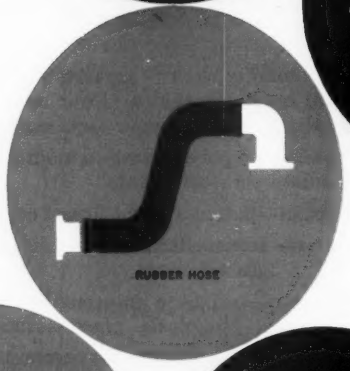

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RUBBER WORLD
EDITORIAL

Inflation Could Reduce Growth Rate By Cuts in Development Budgets

IT IS becoming increasingly clear that there is a deep and probably irreconcilable difference of opinion in Washington on the issue of inflation and proper governmental policies, Ralph Robey of the National Association of Manufacturers, points out in a recent column. The majority opinion of the Joint Economic Committee of Congress on the President's 1959 Economic Report is that until evidence of an immediate inflationary threat is seen, public policy should be to increase governmental spending and not worry so much about a balanced budget. The minority opinion holds that the time to stop inflation is before it starts and that it is of utmost importance not to adopt policies or programs now that will have an inflationary impact.

Ellis B. Gardner, vice president and director of Hewitt-Robins, Inc., in a talk before the New York Rubber Group on March 20, discussed "Inflation and Its Relation to Research and Development," a subject that should be of particular interest to RUBBER WORLD readers. Research and development have a direct relation to wage inflation and government deficit spending, and the connecting link is corporate profits, the amount of corporate profits which is generated and how it is used, it was said.

Inflationary wages on the one hand, competitive prices on the other, and shrinking profit margins in between the two, are making it increasingly difficult to find the money management recognizes as necessary for research and development projects. Only the wealthiest of companies can afford basic research, and those of us with budgets for applied research must ask research and development people to limit objectives, achieve results quickly, and make maximum efficient use of funds under present-day conditions, Mr. Gardner emphasized.

Meanwhile management is faced with a growing need of increased profit margins to permit basic research, to permit going off on a few tangents, and to permit a few mistakes in new product development. At the same time the rising crescendo of new product developments requires more and more funds to produce and market them.

As recently as October, 1958, we presented some information in this column on trends of research and devolopment expenditures in the rubber and chemical industries. Although for the rubber industry these rose to 2.8% on sales in 1957 from 1.1% on sales in 1953, it is not unlikely that the percentage in 1958 was somewhat lower than in 1957.

Unless government limits deficit spending, industry management does everything possible to limit further price increases, and organized labor does likewise for wage increases, inflationary trends may become more pronounced. If so, government, management, and labor may find that they have "killed the goose that laid the golden egg," that is, the research and development on which the growth of the nation and its industry depends. Let us hope we are not headed into a period when outstanding developments cannot be brought into full-scale production because of the squeeze on profits.

R. G. Seaman

EDITOR

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RUBBER WORLD

Z. T. Ossefort

Influence of Accelerator Residues on Age Resistance Of Elastomeric Vulcanizates[1]

By Z. T. OSSEFORT
U. S. Army, Ordnance Corps, Rock Island Arsenal, Rock Island, Ill.

THE great dependence of age resistance of elastomeric vulcanizates upon the curing system used in their preparation is a well-recognized phenomenon (1-4).[2] It has been well established that diene elastomers cured using certain accelerator and peroxide curing agents have superior age resistance, in both "natural" and accelerated aging, over those cured using the more common sulfur-accelerator combinations (5-6).

The reasons for this greater age resistance have been ascribed to various causes, chief among which is the increased stability of the network structures resulting from use of these curing systems (7-8). The latter conclusion is usually supported by the comparison of bond energies of the carbon-carbon bond at approximately 63 kcal./mole with monosulfide at 55 and polysulfide at 28 kcal./mole. (It is implied that the most age-resistant rubbers are those having a preponderance of the more stable carbon-carbon and monosulfide cross-linkages.) But the two observations below are difficult to reconcile with this explanation:

1. The chief manifestations of aging in the diene rubbers are reduced elongation and increased hardness and modulus which result from the *formation* of additional cross-linkages rather than rupture of those already present. As a consequence of this, the presence of inherently more stable structures such as the carbon-carbon cross-linkage may actually lead to poorer age resistance as reflected by physical property changes after aging.

2. Recent studies, the results of which will be furnished later in this paper, have indicated that completely uninhibited peroxide and gamma radiation cured vulcanizates have extremely poor resistance to accelerated aging at 212° F.

Further aging studies on vulcanizates based on the following four curing systems have indicated that only those vulcanizates cured with accelerators (in the absence of elemental sulfur) have excellent age resistance, whether inhibitor has been added or not:

1. Sulfur accelerator (1.75 parts per hundred rubber hydrocarbon (phr) sulfur plus 1.00 phr N-cyclohexyl-2-benzothiazyl sulfenamide[3]).

2. Accelerators only (1.0 phr dicyclopentamethylene thiuram tetrasulfide (DCPTTS[4]) plus 1.0 part mercaptobenzothiazole (MBT).

3. Peroxide (1.0 phr dicumyl peroxide).

4. Radiation (33 megarads[5] gamma radiation).

---

[1]Based on a paper presented at the Fifth Joint Army-Navy-Air Force Conference on Elastomer R&D held at Dayton, O. in Oct., 1958. The opinions or assertions contained herein are not to be construed as official or reflecting the views of the Department of the Army.

[2]Numbers in parentheses refer to Bibliography items at end of this article.

[3]Santocure, Monsanto Chemical Co., rubber chemical department, Akron, O.; Cydac, American Cyanamid Co., rubber chemicals department, Bound Brook, N. J.; Delac S, Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

[4]Sulfads, R. T. Vanderbilt Co., New York, N. Y.; Tetrone A, E. I. du Pont de Nemours & Co., Inc., elastomer chemicals department, Wilmington, Del.

[5]Mega = one million; one rad = the absorption of 100 ergs of energy per gram of material from radiation of any type.

Influence of Accelerator Residues on Aging of Elastomeric Vulcanizates

This work reported in this paper was done to investigate the relative contribution of network stability and inhibition to the age resistance of diene vulcanizates. It was considered that if the stability of the network structure is the dominant factor in age resistance, then further improvement of this resistance could best be achieved by directing efforts toward methods of improving this network stability. If, however, the degree of inhibition is the controlling factor, then improved age resistance might best be achieved by proper selection of inhibitors (antioxidants).

The program revealed that the limiting factor in aging of vulcanizates prepared using sulfur-accelerator combinations and accelerators alone is inhibitor efficiency and not the stability of the network structure. It is shown that the excellent age resistance of certain accelerator cured rubbers, even in the absence of ordinary antioxidants, is due to formation of an extremely active inhibitor formed *in situ* as a reaction product of the accelerators. Residues formed in the vulcanizates during peroxide and radiation curing, on the other hand, tend to make the age resistance of these compounds poorer.

The information presented herein indicates that further improvement in age resistance of the diene rubbers will probably best be achieved through research leading to the development of more efficient inhibitors.

TABLE 1. COMPOUND FORMULATIONS

	Parts by Weight	
Compounding Ingredient	SBR Compound	*Hevea* Compound
Uninhibited SBR 1500	100	
Pale crepe		100
Zinc oxide	3	5
Stearic acid	2	1
Phenyl-beta-naphthylamine (PBNA)		1
Tellurium		0.5
Tetramethylthiuram disulfide (TMTD)		3
MAF (FEF) carbon black	50	50
Curatives	as indicated	
Inhibitor	1 PBNA where indicated	

All test pad cures were for 30 minutes at 307° F. except radiation cures which were accomplished by exposure of 33 megarads of gamma radiation.

(Unless otherwise indicated, the above curing combinations will be the ones referenced throughout this paper).

Since excellent age resistance was obtained with the accelerator cure even in the absence of added inhibitor (antioxidant), these results appear to indicate that this age resistance may be related to the inherent stability of this type of vulcanizate. It is well recognized, however, that certain classes of accelerators provide some antioxidant protection to a vulcanizate (3).

It was the objective of this investigation to attempt to ascertain whether the inhibitor function is dominant in establishing good age resistance or whether such resistance is a prime function of the stability of certain network structures resulting from the use of specific curing systems.

Procedure and Results

Formulations of rubber compounds used in this study are listed in Table 1. These compounds were mill mixed, cured, and tested in accordance with ASTM[6] procedures where applicable. The radiation cures were accomplished in a manner previously described (5). The bulk of the accelerated aging was done in an air oven at 212° F. since previous work had indicated that aging under these conditions could be correlated, at least qualitatively, with "natural" aging. In order to minimize migration of ingredients between compounds during aging, only those vulcanizates having the same inhibition and cure were aged simultaneously.

A sample thickness of 0.040-inch was used throughout since it has been shown (9) that the rate of oxidation may be affected by the rate of diffusion of oxygen into thicker specimens. Since the ultimate elongation varies most regularly with aging and is one of the best indications of the aged condition of SBR vulcanizates, this property was emphasized in the graphical presentation of some of the data. In those cases in which elongation alone is shown, the other properties, such as tensile, modulus, and hardness, showed a degree of deterioration in the respective vulcanizates which was comparable to that indicated by elongation changes.

Two principal techniques were utilized in preparing specimens for aging. In the first, dumbbell and National Bureau of Standards (NBS) (10) strain test specimens of the vulcanizates were acetone extracted (Soxhlet extractor) to remove inhibitors where present, free sulfur, and accelerator residues. In order to establish the efficiency of this extraction and the time required for

[6]American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

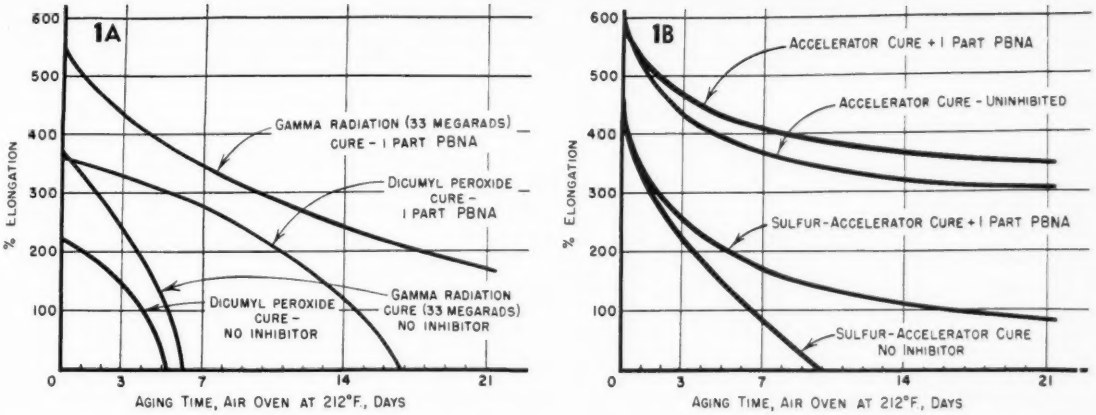
1A
% ELONGATION
AGING TIME, AIR OVEN AT 212°F, DAYS
GAMMA RADIATION (33 MEGARADS) CURE - 1 PART PBNA
DICUMYL PEROXIDE CURE - 1 PART PBNA
DICUMYL PEROXIDE CURE - NO INHIBITOR
GAMMA RADIATION CURE (33 MEGARADS) NO INHIBITOR
1B
% ELONGATION
AGING TIME, AIR OVEN AT 212°F, DAYS
ACCELERATOR CURE + 1 PART PBNA
ACCELERATOR CURE - UNINHIBITED
SULFUR-ACCELERATOR CURE + 1 PART PBNA
SULFUR-ACCELERATOR CURE NO INHIBITOR

Fig. 1. Air oven aging of inhibited *vs.* uninhibited peroxide and gamma radiation cured SBR compounds (A), and inhibited *vs.* uninhibited SBR sulfur and sulfur-type curing systems (B)

complete extraction, SBR vulcanizates were prepared using the base recipe shown in Table 1 except that radioactively tagged PBNA was included. These vulcanizates were acetone extracted, and the counting rate monitored in the extract and in the residual vulcanizate.

The results in Table 2 indicate that the extraction process was very efficient regardless of the type sample, time employed, and curing system except for the radiation cure in which a significantly lower percentage of inhibitor was recovered. Possible reasons for this condition will be mentioned when the aging of radiation cured SBR is discussed.

In the second technique, small quantities of ingredients, as subsequently shown, were incorporated into the vulcanizates by swelling them to the required extent in a toluene solution of the ingredient followed by removal of the toluene by evaporation at room temperature. By proper adjustment of the concentration it was possible to incorporate the desired amount of additive. Upon removal of the toluene the *original* physical properties of the specimens were found to be affected only slightly by this treatment.

TABLE 2. % RADIOACTIVE PBNA EXTRACTED FROM CURED AND UNCURED SBR COMPOUNDS

Cure Used	Type Sample	Extraction Time, Hrs.	% Extracted
Uncured	thin sheet	24	91.0
Sulfur-accelerator	dumbbell	24	92.6
Sulfur-accelerator	dumbbell	48	92.5
Sulfur-accelerator	finely shredded	24	94.6
Sulfur-accelerator	finely shredded	48	94.7
Peroxide	finely shredded	24	91.4
Peroxide	dumbbell	24	91.0
Radiation	dumbbell	24	78.2
Sulfur-accelerator	dumbbell	6	91.3

Relation of Curing System And Antioxidant to Aging

The aging of inhibited and uninhibitied peroxide and radiation cured vulcanizates is compared in Figure 1A. It is very evident that, in the absence of inhibitor, these vulcanizates have extremely poor age resistance. Since the radiation cured rubber *can* have *only* carbon to carbon cross-linkages, and peroxide cured rubber is reported to have these also (11), it would appear that this type of cross-linkage is not intrinsically more resistant to aging as reflected by physical property changes in the vulcanizate.

As indicated earlier, the carbon-carbon cross-linkage is undoubtedly more stable chemically than other types of cross-linkages, but this condition does not necessarily lead to improved age resistance since the stability of the cross-link may be relatively unimportant insofar as the age resistance of the vulcanizate is concerned. At least one other explanation may be advanced for the poor age resistance of these compounds, viz., that a prooxidant is formed in the uninhibited vulcanizates during the curing process. This possibility will be discussed in greater detail later in this paper.

The results of aging tests on inhibited and uninhibited SBR vulcanizates cured using accelerators only and a sulfur-accelerator combination are given in Figure 1B. These data in combination with the data presented above clearly demonstrate that only the accelerator cured rubber has excellent age resistance, whether an inhibitor is present or not. It is in the latter case that the question is most pertinent as to whether this greater age resistance, even without inhibitor, is conferred upon this vulcanizate because of the greater inherent stability of the network structure resulting from this curing system, or, whether some other factor is involved.

Aging of Vulcanizates Cured with Accelerators Only

The data in Table 3 and the curves in Figure 2A illustrate aging results obtained using the uninhibited

TABLE 3. AGING OF UNINHIBTED ACCELERATOR CURED SBR

Time in Air Oven at 212° F.	Original	Days 3	7	14	21
Untreated Vulcanizate					
Tensile, psi.	2745	2790	2940	2380	2150
200% Modulus, psi.	380	645	925	980	700
300% Modulus, psi.	965	1645	2095	2210	1880
Elongation, %	590	430	400	320	310
Hardness, Shore A	70	69	68	70	69
NBS strain @ 400 psi., in %	171	137	131	125	115
Acetone Extracted					
Tensile, psi.	2535	2010	810	*	*
200% Modulus, psi.	520	450	–	*	*
300% Modulus, psi.	1410	1285	–	*	*
Elongation, %	450	380	120	*	*
Hardness, Shore A	68	68	78	*	*
NBS strain @ 400 psi., in %	185	154	118	*	*
Acetone Extracted—Then Impregnated with Equivalent Extract					
Tensile, psi.	2280	2375	2200	1965	1520
200% Modulus, psi.	650	1055	1190	1430	–
300% Modulus, psi.	1435	2260	–	–	–
Elongation, %	400	300	280	240	170
Hardness, Shore A	71	72	74	80	81
NBS strain @ 400 psi., in %	–	–	–	–	–
Acetone Extracted—Then Impregnated with One Part PBNA					
Tensile, psi.	2465	2425	2505	1125	*
200% Modulus, psi.	550	775	755	–	*
300% Modulus, psi.	1435	1720	1755	–	*
Elongation, %	510	440	330	160	*
Hardness, Shore A	69	74	77	79	*
NBS strain @ 400 psi., in %	170	144	133	92	*
Acetone Extracted—Then Impregnated with One Part Zinc Dimethyl Dithiocarbamate					
Tensile, psi.	2425	2530	2415	2380	2160
200% Modulus, psi.	435	1190	1335	2140	–
300% Modulus, psi.	1315	2120	–	–	–
Elongation, %	480	340	290	230	200
Hardness, Shore A	67	68	70	74	78
NBS strain @ 400 psi., in %	183	113	99	76	62

*Samples too poor for testing.

TABLE 4. AGING OF TMTD CURED SBR AND NATURAL RUBBER

Time in Air Oven at 212° F.	Original	Days 3	7	14	21
Untreated SBR-Cured with 3 Parts TMTD					
Tensile, psi.	3570	3770	3630	3315	3065
200% Modulus, psi.	1005	1200	1380	1715	1915
300% Modulus, psi.	2255	2820	3005	–	–
Elongation, %	430	380	350	280	260
Hardness, Shore A	69	71	73	74	77
NBS strain @ 400 psi., in %	140	117	106	89	85
Same as above, but acetone extracted prior to aging					
Tensile, psi.	3290	3020	1180	1170	1010
200% Modulus, psi.	790	970	–	–	–
300% Modulus, psi.	2090	2470	–	–	–
Elongation, %	405	350	150	85	50
Hardness, Shore A	71	72	80	86	89
NBS strain @ 400 psi., in %	138	125	77	40	†
Untreated Natural Rubber (Recipe as shown in Table 1)					
Tensile, psi.	2390	1990	1785	1100	*
200% Modulus, psi.	1140	1310	1300	880	*
300% Modulus, psi.	2065	–	–	–	*
Elongation, %	330	270	250	210	*
Hardness, Shore A	70	69	67	65	*
NBS strain @ 400 psi., in %	122	105	104	114	*
Same as previous compound, but acetone extracted prior to aging					
Tensile, psi.	2290	1270	390	*	*
200% Modulus, psi.	1110	840	420	*	*
300% Modulus, psi.	2200	–	–	*	*
Elongation, %	300	250	200	*	*
Hardness, Shore A	68	65	56	*	*
NBS strain @ 400 psi., in %	120	136	†	*	*

*Samples too poor for testing.
†Broke.

accelerator (DCPTTS plus MBT) cured SBR. The very marked loss in aging resistance after acetone extraction of this "uninhibited" vulcanizate is most in evidence. Impregnating the vulcanizate with an amount of extract equivalent to that removed by the acetone extraction (approximately 4% by weight) restores the excellent aging resistance. The data in Table 3 show that the original properties of the acetone extracted vulcanizate do not differ drastically from those of the untreated vulcanizate. These latter two conclusions demonstrate that the outstanding age resistance of this vulcanizate is due to the formation of an extremely active inhibitor formed from accelerator residues *in situ* during the curing process.

In the case of the TMTD cured natural rubber (discussed later) the bulk of the acetone extract was identified, by infrared analysis and melting point data, as zinc dimethyl dithiocarbamate (ZnDMDC). This agrees with the findings of others (12-14).

The extract from SBR cured using DCPTTS plus MBT has not been positively identified as yet. It does not appear to be any of the commercially available zinc dialkyl dithiocarbamates. In view of the above findings, the acetone extracted vulcanizate was impregnated with one part of ZnDMDC prior to aging. As shown in Table 3 and Figure 2A, the excellent age resistance of the original vulcanizate was almost completely restored. When this vulcanizate was impregnated with a "conventional" antioxidant (PBNA), the age resistance was improved somewhat over that of the acetone extracted sample, but not nearly to the extent of either the extract or the ZnDMDC impregnated vulcanizates. Results on the *inhibited* accelerator cured vulcanizate were nearly identical to those just described and therefore will not be reported upon in detail.

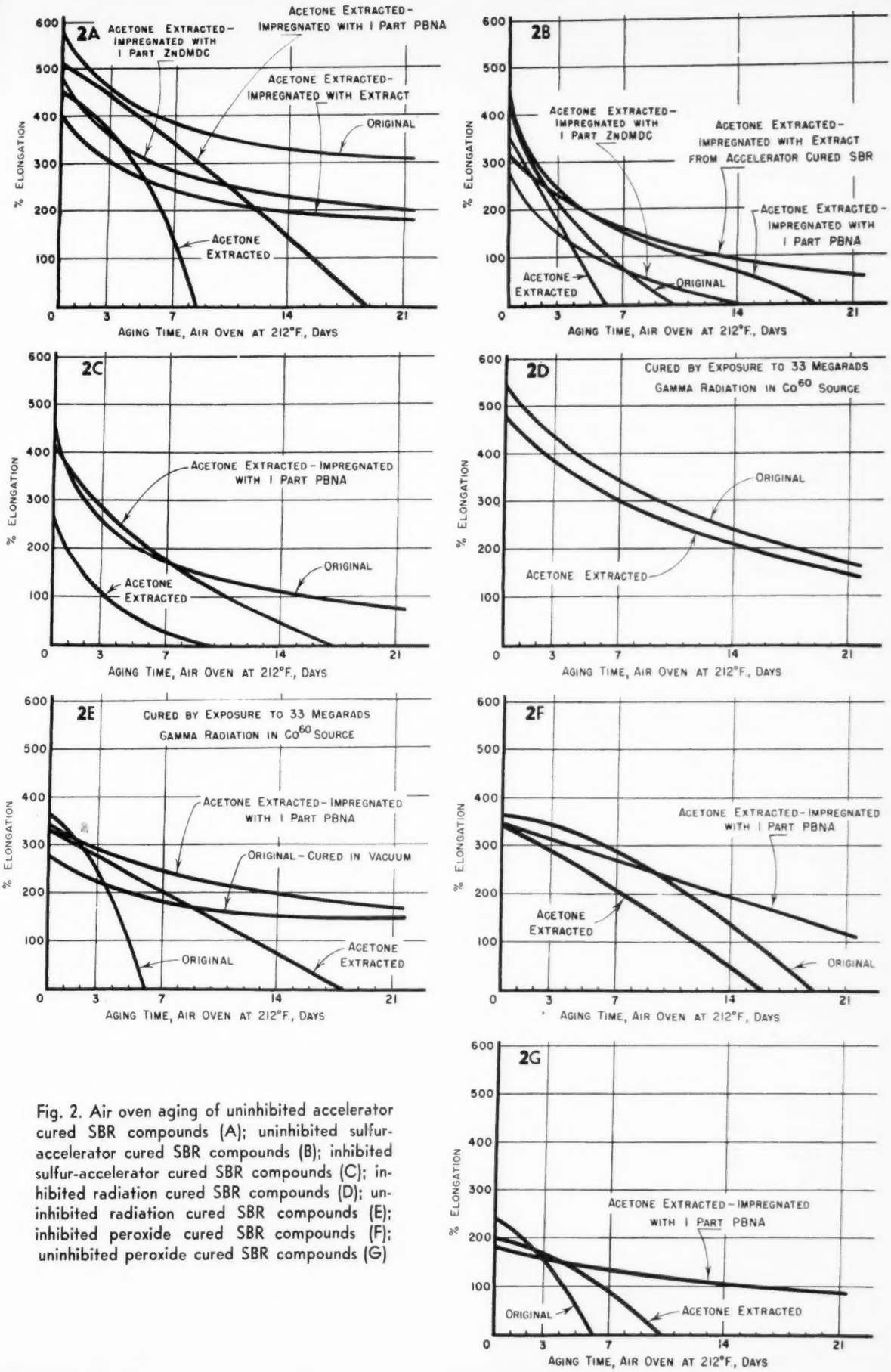

Fig. 2. Air oven aging of uninhibited accelerator cured SBR compounds (A); uninhibited sulfur-accelerator cured SBR compounds (B); inhibited sulfur-accelerator cured SBR compounds (C); inhibited radiation cured SBR compounds (D); uninhibited radiation cured SBR compounds (E); inhibited peroxide cured SBR compounds (F); uninhibited peroxide cured SBR compounds (G)

In order to explore the generality of the above phenomena the aging of untreated and acetone extracted SBR and natural rubber cured with tetramethylthiuram disulfide (TMTD) was examined. These data (Table 4) indicate that in each case the excellent age resistance of the original vulcanizates is lost when the samples are extracted. Similar results on natural rubber were reported in two recent papers from the British Rubber Producers Research Association (15-16).

Sulfur-Accelerator Cured Vulcanizates

Results on the aging of uninhibited sulfur-accelerator cured SBR and natural rubber are presented in Table 5 and Figure 2B. In this case again, the acetone extracted vulcanizates show the poorest age resistance. It appears that the residues from curing function as inhibitors in this instance also. Impregnation of an extracted vulcanizate with either PBNA or ZnDMDC does not improve the age resistance as much as impregnating with an extract from the DCPTTS plus MBT cured SBR previously discussed.

It will be observed that the aging of the extracted vulcanizates is, at least qualitatively, the same in the case of both the accelerator (Table 3) and sulfur-accelerator cures (Table 5). This fact suggests that the superior age resistance of the accelerator cured vulcanizate is dependent primarily on the presence of a very efficient inhibitor formed *in situ* during vulcanization, *or* that certain network structures are *per se* more susceptible to inhibition by specific types of inhibitors. The fact that extracted accelerator cured rubber is improved in age resistance to a much greater degree than is extracted *sulfur-accelerator* cured rubber, when both are impregnated with ZnDMDC, is evidence toward the latter conclusion.

In Figure 2C some results on aging of inhibited sulfur-accelerator cured SBR are provided. Observations relating to these data are approximately the same as for the uninhibited compound just discussed.

Gamma Radiation Cured SBR

Results of aging tests on radiation cured SBR are furnished in Table 6 and Figures 2D and 2E. In Figure 2D it is shown that the inhibited radiation cured SBR, in contrast with rubbers based upon the types of cures discussed above, resists aging as well after acetone extraction as before. Since uninhibited radiation cured SBR was shown earlier (Figure 1A) to have extremely poor resistance to aging, it appears that the acetone extraction removes an ingredient harmful to good age resistance as well as the antioxidant.

Inasmuch as this radiation curing was conducted in the presence of oxygen, it is surmised that the prooxidant may be peroxide resulting from radiation curing in the presence of oxygen. The contribution of "frozen in" free radicals, formed during the radiation process, to this poor age resistance was also considered. However, the fact (as shown in Figure 2E) that radiation curing in the absence of oxygen results in a vulcanizate with good age resistance, makes the peroxide formation a more reasonable explanation.

TABLE 5. AGING OF UNINHIBITED SULFUR-ACCELERATOR CURED SBR AND NATURAL RUBBER

		Days			
Time in Air Oven at 212° F.	Original	3	7	14	21
Untreated SBR					
Tensile, psi.	2625	2320	1640	1100	*
Elongation, %	450	220	80	–	*
Hardness, Shore A	67	76	–	–	*
NBS strain @ 400 psi., in %	158	74	–	–	*
Acetone Extracted SBR					
Tensile, psi.	2155	1675	*	*	*
Elongation, %	350	180	*	*	*
Hardness, Shore A	63	77	*	*	*
NBS strain @ 400 psi., in %	142	88	*	*	*
Acetone Extracted SBR—Impregnated with One Part PBNA					
Tensile, psi.	2720	2690	1705	945	*
Elongation, %	410	260	140	70	*
Hardness, Shore A	71	79	82	92	*
NBS strain @ 400 psi., in %	139	93	77	39	*
Acetone Extracted SBR—Impregnated with Equivalent Extract					
Tensile, psi.	2545	1825	1965	1320	1080
Elongation, %	320	210	150	100	70
Hardness, Shore A	65	76	78	80	82
NBS strain @ 400 psi., in %	137	71	58	45	36
Acetone Extracted SBR—Impregnated with One Part ZnDMDC					
Tensile, psi.	2155	1735	1545	785	*
Elongation, %	280	130	80	–	*
Hardness, Shore A	65	78	79	84	*
NBS strain @ 400 psi., in %	135	52	48	30	*
Untreated Natural Rubber					
Tensile, psi.	2260	910	*	*	*
Elongation, %	350	250	*	*	*
Hardness, Shore A	67	66	*	*	*
NBS strain @ 400 psi., in %	138	130	*	*	*
Acetone Extracted Natural Rubber					
Tensile, psi.	1880	100	*	*	*
Elongation, %	300	180	*	*	*
Hardness, Shore A	70	54	*	*	*
NBS strain @ 400 psi., in %	128	†	*	*	*

*Samples too poor for testing.
†Broke.

It is also shown in this figure that acetone extraction of an *uninhibited* radiation cured SBR improves age resistance and that impregnation with PBNA yields further improvement. The fact that inhibited radiation cured SBR ages well even after acetone extraction, suggests the possibility that the very poor age resistance of the uninhibited radiation cured rubber is due to the presence of peroxide residues resulting from curing in the presence of oxygen and that the inhibitor is very active combating these peroxides during the curing process. Comparing Figure 2D with Figure 2E, it

TABLE 6. AGING OF RADIATION CURED SBR

Time in Air Oven at 212° F.	Original	Days 3	7	14	21
Inhibited—Untreated					
Tensile, psi.	2450	2680	2640	1330	760
200% Modulus, psi.	370	585	800	625	–
300% Modulus, psi.	1650	1450	1840	–	–
Elongation, %	540	420	350	250	170
Hardness, Shore A	67	68	68	70	71
Inhibited—Acetone Extracted					
Tensile, psi.	2540	2395	1910	1360	1065
200% Modulus, psi.	690	660	730	1065	–
300% Modulus, psi.	1595	1605	1665	–	–
Elongation, %	490	390	310	220	150
Hardness, Shore A	70	70	73	75	75
Uninhibited—Untreated					
Tensile, psi.	2980	2230	*	*	*
200% Modulus, psi.	885	760	*	*	*
Elongation, %	370	240	*	*	*
Hardness, Shore A	70	67	*	*	*
Uninhibited—Acetone Extracted					
Tensile, psi.	2950	2740	1390	450	*
200% Modulus, psi.	1470	1220	1175	–	*
Elongation, %	340	290	210	80	*
Hardness, Shore A	74	74	75	78	*
Uninhibited—Acetone Extracted —Impregnated with One Part PBNA					
Tensile, psi.	3045	3110	2835	1750	1285
200% Modulus, psi.	1260	1340	1615	1625	–
Elongation, %	340	290	260	200	170
Hardness, Shore A	73	74	76	77	79
Uninhibited—Cured in Vacuum					
Tensile, psi.	3070	2870	1560	1445	1010
200% Modulus, psi.	1590	1375	1410	–	–
Elongation, %	290	230	190	170	150
Hardness, Shore A	67	69	70	71	72

*Samples too poor for testing.

TABLE 7. AGING OF PEROXIDE CURED SBR

Time in Air Oven at 212° F.	Original	Days 3	7	14	21
Inhibited—Untreated					
Tensile, psi.	2810	2815	2420	590	*
200% Modulus, psi.	760	945	1075	–	*
Elongation, %	360	330	290	120	*
Hardness, Shore A	71	72	74	74	*
Inhibited—Acetone Extracted					
Tensile, psi.	2935	2470	1445	640	*
200% Modulus, psi.	825	1250	–	–	*
Elongation, %	350	280	200	60	*
Hardness, Shore A	71	73	76	84	*
Inhibited—Acetone Extracted— Impregnated with One Part PBNA					
Tensile, psi.	2840	2845	2380	1540	1145
200% Modulus, psi.	975	1360	1410	–	–
Elongation, %	340	310	270	190	120
Hardness, Shore A	72	75	77	78	81
Uninhibited—Untreated					
Tensile, psi.	2485	1195	*	*	*
Elongation, %	220	160	*	*	*
Hardness, Shore A	75	76	*	*	*
Uninhibited—Acetone Extracted					
Tensile, psi.	1860	1515	800	*	*
Elongation, %	200	170	90	*	*
Hardness, Shore A	74	76	81	*	*
Uninhibited—Acetone Extracted —Impregnated with One Part PBNA					
Tensile, psi.	2305	2040	1755	1190	1025
Elongation, %	190	170	140	110	90
Hardness, Shore A	77	78	80	81	82

*Samples too poor for testing.

is evident that the acetone extracted *inhibited* rubber resists aging to a much greater extent than the acetone extracted *uninhibited* rubber.

Since it may be assumed that the efficiency of the extraction in removing prooxidants is the same in each case, it appears that the greater amount of inhibitor retained by the radiation cured inhibited rubber (see Table 2) may be effective in improving the age resistance of this compound. It is possible that this "retained" inhibitor has become permanently fixed to the polymer chains by a grafting process during the radiation and is consequently no longer acetone extractable.

Peroxide Cured SBR

The data on aging of various peroxide cured samples are given in Table 7 and Figures 2F and 2G. As indicated in Figure 2F, acetone extraction of an *inhibited* vulcanizate in this case makes the age resistance slightly poorer. In contrast with this observation, it is shown in Figure 2G that acetone extraction of an uninhibited sample improves age resistance slightly. The best aging in each instance is obtained using the rubber which has been first extracted with acetone and then impregnated with antioxidant before the aging tests were run.

From these data it would appear that the peroxide cured SBR contains a residual ingredient or ingredients which behave as prooxidants thereby interfering with age resistance of the vulcanizates. In the case of the inhibited compound removal of these prooxidants by acetone extraction is invariably accompanied by removal of the antioxidant. Since the net effect is slightly poorer age resistance, it is apparent that the beneficial action of the antioxidant outweighs the harmful effects of the prooxidant. However, where no inhibitor is present (Figure 2G) acetone extraction (removal of prooxidant) invariably results in better age resistance. As mentioned above, addition of antioxidant to an extracted vulcanizate yields the greatest improvement since the antioxidant is in this case available for protecting the vulcanizate and is not partially consumed in counteracting the effects of the "residual peroxides" which were left in peroxide cured SBR.

Summary and Conclusions

It has been shown that the age resistance of elastomeric vulcanizates is influenced to a very marked degree by residues formed *in situ* in the vulcanizate during the curing process. By a dual process of removal of these residues and incorporation of selected ingredients subsequent to vulcanization, it has been shown that age resistance (as measured by accelerated oven aging tests at 212° F.) in rubbers cured by sulfur and/or sulfur bearing accelerators, is a prime function of these residues and nearly independent of the stability of the network structure.

An extremely active inhibitor is formed *in situ* during vulcanization of SBR and natural rubber using thiuram accelerators. This inhibitor can be used to "reinhibit" acetone extracted accelerator cured rubber. When added to sulfur-accelerator, peroxide, or radiation cured vulcanizates, it improves their age resistance, but only in the case of the sulfur-accelerator cured rubber is this improvement better than with conventional inhibitors. This leads to the conclusion that the efficiency with which an inhibitor protects a vulcanizate varies widely, and conversely it appears that certain types of network structures are more readily protected or that certain inhibitors can function more efficiently in the protection of certain structures than others.

In the case of TMTD cured natural rubber (zinc oxide present), the bulk of the accelerator residue is ZnDMDC, and this residue has been shown to function as a very efficient antioxidant when incorporated into acetone extracted accelerator cured vulcanizate. It is no more effective than conventional inhibitors, however, when incorporated into an acetone extracted sulfur-accelerator cured vulcanizate. Finally, it has been shown that acetone extraction of the various vulcanizates may lead to improvement or worsening of their age resistance, depending upon the nature of the residues resulting from the curing process.

Acknowledgment

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Internal Mixer Power Requirements Investigated

A study has been reported in the Russian journal, *Kauchuk i Rezina* [4, 11-14, (1958)], on the use of a two-speed laboratory mixer to investigate the use of electric power during mixing. The article was titled, "Required Power and Consumption of Electric Energy during High-Speed Mixing of Rubbers."

The NIIkhimmash specially constructed a two-speed mixer so that the front rotor could be run 40.5 revolutions per minute or 20 revolutions per minute. The power of the feed hopper and the pressure over the mixer were also increased so that it was possible to cut the mixing time in half. The loads on the electric motor during agitation and mixing were studied. The work was conducted during the years 1954 and 1955.

The following were the conditions set up in the mixer: mixing chamber capacity, two liters; rotor speeds, 27/32, 35/40, 42/50, 53/63, and 84/100 revolutions per minute; volume of mixture, 1.5 kg.; motor rating 40 kw.; power requirement of the blank run, 1.8 kw. The investigations showed that the maximum power required during mixing depends upon the conditions, speed of the rotors, time of mixing, and the order of feeding of the ingredients. For example, doubling the speed of the rotors with a corresponding shortening of the mixing cycle, and with the ingredients fed successively, the power requirement increases 160 to 300%.

Other conditions that were investigated were the temperature of the mixing chmaber and the mixture, the method of feeding the materials into the mixer, and the time of mixing on the losses of electric energy.

Some conclusions drawn were that the consumption of electric energy was lowered when the time of mixing was shortened, but it was pointed out that this decreased consumption would not be noticeable under industrial conditions. It proved profitable to increase the rotor speed, especially during simultaneous ingredient feeding and at increased temperature.

Studies in Tire Cord Adhesion[1]

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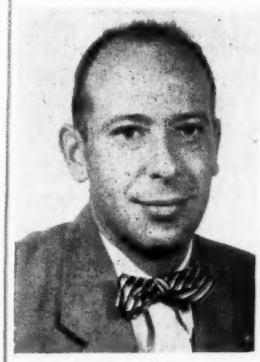

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COMPARISONS in general of adhesion of butyl rubber systems and of high unsaturation elastomer systems have been considered in the past in terms of reaction efficiency. The low concentration of reactive sites in butyl has been cited as the explanation of differences noted in these comparisons. Tire cord adhesion studies and comparisons are well-known examples of this kind of presentation. Recently a system designed to produce improved cord adhesion to a butyl carcass involving an apparently more reactive latex elastomer system was described.[2] The tire cord was given a Gen-Tac[3] (terpolymer of butadiene-styrene-vinyl pyridine), resorcinol formaldehyde-latex treatment followed by a brominated butyl rubber cement treatment. This double dipped cord was then cured to a butyl rubber carcass.

Since the scope of our investigation of this general type of system was broader than that described above, this report summarizes the work at Esso Research and provides an improved understanding of the process. Our study of cord adhesion may be subdivided into these areas: (1) the reactivity of the latex elastomer; (2) the significance of RF concentration; (3) the nature of the cement polymer and cement composition.

[1]Presented before the Division of Rubber Chemistry, ACS., Chicago, Ill., Sept. 12, 1958.
[2]United States patent No. 2,822,311 (Feb., 1958).
[3]General Tire & Rubber Co., chemical division, Akron, O.
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Effect of Latex Elastomer Reactivity on Cord Adhesion

Since an unsaturated latex elastomer is used in adhesive systems, its chemical reactivity must be considered to be of importance. The olefin structure reactivity classification[4] shown in Table 1 may be used to classify the elastomers normally considered in the preparation of materials for cord adhesives. Although butyl rubber contains a Type IV olefin structure, the concentration compared with natural rubber is very low, and overall chemical efficiency would be expected to be low. Halogenation of butyl would be expected to increase its chemical reactivity, with the bromine-con-

TABLE 1. OLEFIN STRUCTURE REACTIVITY CLASSIFICATION FOR VARIOUS ELASTOMERS

Olefin Type	Olefin Structure	Elastomers
I	$R-C(H)=C(H)-H$	
II	$R-C(H)=C(H)-R'$	SBR,[a] Gen-Tac[a]
III	$R-C(R')=C(H)-H$	
IV	$R-C(R')=C(H)-R''$	Butyl, MD-551,[b] MD-571,[b] neoprene, natural rubber
V	$R-C(R')=C(R'')-R'''$	

[a]It is recognized that styrene butadiene polymers may contain some Type I olefin as a result of 1,2-addition.
[b]MD-551 is a chlorine-containing isoolefin-multiolefin copolymer, Enjay Co., Inc. MD-571 contains bromine.

TABLE 2. BUTYL RUBBER CARCASS STOCK

Enjay Butyl 325	100.00
MPC black	24.00
SRF black	16.00
Elastopar[a]	1.00
Necton 60[b]	12.50
Amberol ST-137X[c]	2.50
Zinc oxide	5.00
Sulfur	2.00
Tellurac[d]	1.25

[a]N-methyl-N,4-dinitrosoaniline, Monsanto Chemical Co., St. Louis, Mo.
[b]Petroleum-base plasticizer, Esso Standard Oil Co., New York.
[c]Non-reactive phenolic resin, Rohm & Haas Co., Philadelphia, Pa.
[d]Tellurium diethyl dithiocarbamate, R. T. Vanderbilt Co., New York.

Studies In Tire Cord Adhesion

This paper presents the results of a study of some of the variables in tire cord adhesion in a system composed of a natural rubber latex-resorcinol formaldehyde adhesive applied to nylon cord followed by the application of a cement composed of a bromine-containing multiolefin isoolefin copolymer, and finally cured to a butyl rubber carcass stock.

This work reports the tire cord adhesion study as conducted in the following areas: (1) the reactivity of the latex elastomer; (2) the significance of RF concentration; and (3) the nature of the cement polymer and cement composition.

The investigation was quite wide in scope and serves to amplify and further explain the work reported on a system designed to produce improved cord adhesion to a butyl rubber carcass involving an apparently more reactive latex elastomer system in United States patent No. 2,822,311.

The results indicate that the principal contribution to adhesion comes from the resorcinol formaldehyde resin. The addition of the latex elastomer can enhance or detract from this adhesion, depending upon the chemical nature of the latex elastomer.

(This is a second report on this continuing work to develop a fully satisfactory cord treatment to insure cord adhesion in the production of a successful butyl rubber tire. The first report, covering some laboratory work and an examination of the chemistry of cord adhesion appeared in RUBBER WORLD, in our December, 1957, issue and was prepared by these same authors —EDITOR.)

taining polymer more reactive than the chlorine-containing polymer.

Nylon cords were double-treated[5] (RFL and cement), and cured to the butyl carcass stock shown in Table 2 for 25 minutes at 320° F. The cement consisted of a mixture of 100 parts of a bromine-containing isoolefin multiolefin copolymer (MD-571)[6] and 50 parts of carbon black in hexane.

Latices of various olefin reactivity compositions were used in the RFL dip, and the results of this series of experiments are shown in Table 3. Type IV olefin latex elastomers show obviously better adhesion than do Type II olefin latex polymers. In this series an experiment in which elastomer solids were omitted is included, and the nylon adhesion in this case falls between that of a Type II and Type IV olefin elastomer-containing dip.

The significance of elastomer olefin activity can also be shown in other systems. A broad range of latex mixtures of natural rubber and Gen-Tac in RFL dips was investigated with regard to cord adhesion, and the results are shown in Table 4. An obvious synergism is observed which cannot be resolved completely at this time, but variation of elastomer olefin reactivity appears to be involved.

Another synergism which can be related to elastomer olefin reactivity can be shown by cord adhesion measurements in the system which comprises natural rubber-RFL dip and carcass of SBR, natural rubber, and their

TABLE 3. COMPARISON OF LATEX ELASTOMER REACTIVITIES IN NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS

Latex	Olefin Type	"H" Adhesion 70° F., Lbs./End*
Natural	IV	19.0
MD-571	IV	17.7
Gen-Tac	II	14.1
SBR	II	14.1
None	—	16.0

Latex Dip Formulation		Cement Formulation	
Latex solids	2%	MD-571	100
Resorcinol	0.38%	MPC black	50
Formaldehyde	0.6	15 wt. % in hexane	
Water	97.02		
Preage pH	8.5		

*Lyons, Conrad, Nelson. *Rubber Chem. Tech.*, 20, 268 (1947).

TABLE 4. NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS WITH MIXTURES OF NATURAL RUBBER AND GEN-TAC LATICES

Latex Mixture Composition*		"H" Adhesion 70° F.,
Natural	Gen-Tac	Lbs./End
100	0	18.5
95	5	17.2
90	10	18.6
85	15	18.7
75	25	21.2
50	50	20.2
25	75	19.8
15	85	19.9
10	90	17.3
0	100	14.4

Latex Dip Formulation

Latex solids	15 %
Resorcinol	1.1%
Formaldehyde (37%)	1.8%
Water	82.1%
Preage pH	8.5

Cement as described in Table 3

*Wt. % solids.

[5]Cord was dipped into the RFL mix and dried at 250° F. for five minutes. The dried cord was then cement treated and dried at 250° F. for two minutes.

[6]Enjay Co., Inc., New York, N. Y.

TABLE 5. NYLON CORD ADHESION TO VARIOUS CARCASS STOCKS

Elastomer Composition in Carcass Stock	"H" Adhesion 70° F., Lbs./End
100% SBR	14.9
67 wt. % SBR—33 wt. % smoked sheet	21.8
33 wt. % SBR—67 wt. % smoked sheet	16.1
100% smoked sheet	15.8

Dip Formulation	
Natural rubber latex solids	15 %
Resorcinol	2.2%
Formaldehyde (37%)	3.5%
Water	79.3%
Preage pH	8.5

Carcass Formulation (Pts. by Wt.)	
Polymer	100
PBNA[a]	1
Gastex[b]	20
Philblack O[c]	20
ZnO	5
Coray 230[d]	10
Sulfur	3
Altax[e]	1

[a]Phenyl beta naphthylamine.
[b]SRF black, Godfrey L. Cabot, Inc., Boston, Mass.
[c]HAF black, Phillips Chemical Co., Akron.
[d]Petroleum-base plasticizer, Esso Standard Oil Co.
[e]Benzothiazyl disulfide, R. T. Vanderbilt Co.

mixtures (Table 5). In this instance the reactivity of carcass stock elastomer in the bond area appears to have an important effect on cord adhesion. Variations in the polymer composition of the carcass stock in these experiments produce modulus variations which might be predicted to affect "H" test results. Although this is a potential variable, our studies of variation in the modulus of butyl carcass stocks in the butyl adhesion system have indicated relatively small effects on this cord adhesion measurement.[7]

Relation of RF Concentration to Cord Adhesion

The location of the dip mix components on the cord has been shown to affect adhesion.[7] A series of experiments with natural rubber-RFL dip was selected to determine the dip pickup and RF concentration relation to adhesion, since the studies on location of dip components also involved changes in this variable. A summary of these results is recorded in Table 6. In dips 1 and 2, at the same RF concentration based on latex elastomer (moles of RF charged/100 grams of latex solids—mhr), little change in adhesion is observed for a broad change in pickup and RF concentration based on the total dip. Another large pickup reduction in Dip 3 also produces no effect on adhesion. With Dip 4 at a 0.3% RF concentration based on total dip, the adhesion finally falls off.

Three variables appear to be involved: (a) RF dip concentration; (b) mhr RF concentration; (c) dip pickup. In Table 7 the results of a series of experiments are described which clearly select the RF concentration based on the total dip as the most significant of these three variables. A minimum quantity of RF resin appears to be required in the bond area, independent of the latex elastomer concentration present. With a dip that has a 0.6% RF concentration with no latex present, and in the double-dip system 16 lbs./end adhesion at 70° F. was obtained. The minimum required quantity for optimum adhesion is therefore about 0.6% RF in the dip. Any contribution that a latex elastomer in the dip may make to adhesion would then be expected to depend upon its reactivity.

[7]A. L. Miller, S. B. Robison, RUBBER WORLD, 137, 397 (1957).

The Nature of the Cement

A variable in the reactivity of the cement polymer (MD-571) is the bromine content. The results of a study of this variable are shown in Table 8. As the bromine content falls below about 1.4 wt. %, the adhesive ability decreases in conjunction with reduced olefin reactivity.

A comparison of the activation due to bromine (MD-571) and chlorine (MD-551) with the control,

TABLE 6. NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS AND DIP COMPOSITION

Dip mix number	1	2	3	4
Total solids %	17.9	8.4	1.2	0.8
RF concentration in the dip %	1.8	0.9	0.6	0.3
Mhr*	0.21	0.21	1.72	0.84
Dip pickup, wt. %	7.1	4.0	1.5	0.5
"H" adhesion 70° F., lbs./end	20.2	18.0	18.8	13.0

Cement composition as in Table 3

*mhr—moles of RF charged/100 gms. of latex solids.

TABLE 7. NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS AND RF CONCENTRATION

Dip total solids, %	2.8	1.6	0.83
RF concentration, mhr	0.21	0.43	0.86
% in dip	0.3		
"H" adhesion 70° F., lbs./end	14.0	14.6	13.0
Dip total solids, %		1.9	1.2
RF concentration, mhr		0.42	0.86
% in dip	0.6		
"H" adhesion 70° F., lbs./end		19.1	20.7

Cement treat composition as in Table 3

TABLE 8. BROMINE CONTENT OF MD-571 CEMENT AND NYLON CORD ADHESION TO A BUTYL RUBBER CARCASS

MD-571 Bromine Content, Wt. %	"H" Adhesion 70° F., Lbs./End
2.45	18.9
2.0	17.2
1.4	18.2
0.43	15.4
0.17	10.7

Natural rubber latex dip formulation as in Table 4

Cement formulation as in Table 3

Enjay Butyl 268 is shown in cements in Table 9, and as carcass stock polymers without the cement treat in Table 10. MD-551 and MD-571 carcass stock formulations are shown in Table 11. The adhesion results based upon the activation caused by bromine *vs.* chlorine *vs.* no halogen content agree with the predictions in regard to halogen and olefin activities.

Finally, some impression of the effect of carbon black on the cement function is required. Such an examination is described in Table 12. The inclusion of carbon black over a broad range of compositions produces a large adhesion increase with the largest change at low black concentrations. Channel black produces better adhesion than furnace black.

Summary and Conclusions

From the work described the following observations are made:

(1) The latex elastomer in RFL may contribute to adhesion if its olefin structure is sufficiently reactive. A reactive olefin structure at low concentration, as in butyl, can be made sufficiently effective when halogen is present in the molecule. Bromine is observed to provide better adhesion than chlorine. If the olefin structure is at a lower activity level, an adhesion loss due to the presence of latex elastomer in the dip is observed.

(2) The cement polymer or the carcass polymer reactivity also determines adhesion. Here again, a brominated polymer (MD-571) will be more reactive than a chlorinated polymer (MD-551). With high unsaturation carcass polymers, reactivity differences can also be observed in cord adhesion terms.

(3) The concentration of the RF resin in the total dip appears to have a minimum value below which adhesion falls off sharply. This concentration appears to be independent over a wide range of the amount of latex elastomer in the dip. These data may be considered to confirm the previously noted observation that even an active latex elastomer contributes only a little to "H" test cord adhesion values.

(4) The concentration of halogen in the cement polymer (MD-571, 551) has a minimum value below which adhesion decreases. This suggests a minimum of chemical reactivity is required in the carcass or cement compositions.

(5) The cement polymer must contain carbon black, preferably channel black, for optimum adhesion. Curatives are not required in the cement since carcass stocks of the cement polymer, fully compounded show substantially the same adhesion as those obtained with cements without curatives.

TABLE 9. NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS AND CEMENT POLYMER REACTIVITY

Cement Polymer	"H" Adhesion 70° F., Lbs./End
Enjay Butyl 268	8.8
MD-551	11.0
MD-571	16.5

Natural rubber latex dip formulation as in Table 4

Cement formulation as in Table 3

TABLE 10. NYLON TIRE CORD ADHESION AND THE REACTIVITY OF THE CARCASS POLYMER

Carcass Stock	"H" Adhesion 70° F., Lbs./End
Enjay Butyl 325	8.4
MD-551 (Table 11)	14.0
MD-571 (Table 11)	17.8

No cement used

Natural rubber latex dip formulation as in Table 4

TABLE 11. SPECIAL CARCASS FORMULATIONS

MD-551	100	MD-571	100
Stearic acid	0.5	Stearic acid	0.5
SRF black	25	SAF black	30
HAF black	15	FT black	20
Amberol ST-137[a]	5	Amberol ST-137	5
ZnO	5	ZnO	5
S	1	S	1
Tellurac	1	Tellurac	1
Sulfasan R[b]	1	Sulfasan R	2
PBNA	0.5	Suconox 12	1
Suconox-12[c]	0.5	Necton 60	5
Necton 60[d]	5		

NOTE: Butyl carcass formulation in Table 2.
[a]Reactive phenolic resin, Rohm & Haas.
[b]4,4'-Dithiomorpholine, Monsanto Chemical Co.
[c]N-lauroyl para amino phenol, Sumner Chemical Co., Division of Miles Laboratories, New York.
[d]Petroleum-base plasticizer, Esso Standard Oil Co.

TABLE 12. CEMENT COMPOSITION AND NYLON TIRE CORD ADHESION TO A BUTYL RUBBER CARCASS

MD-571	100	100	100	100
MPC carbon black	0	25	50	70
"H" adhesion, 70° F., lbs./end	12.5	18.6	18.5	18.0

All cements 15 wt. % in hexane

Natural rubber latex dip formulations as in Table 4

New Flexible Rubber Mold Material

A new two component system for making flexible polysulfide rubber molds, which are particularly useful for casting gypsum patterns or models with fine detail or undercuts, has been developed. The new material, called "Smooth-On" is available in three grades from Smooth-On Mfg. Co., Jersey City, N. J.

Wing-Stay 100 as an Antioxidant And Antiozonant—II[1]

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THE following installment concludes the informative article on the use of Wing-Stay 100 as an antioxidant and as an antiozonant which was begun in our March issue.

Antioxidant for SBR Vulcanizates

Vulcanizates of the various Plioflex polymers were made by curing six- by six- by 0.025-inch sheets for 90 minutes at 285° F. Formulations were the same as those used for scorch determinations (Table 1).[2] These vulcanizates were evaluated by three methods, namely, oxygen absorption, creep and air bomb aging.

Oxygen absorption curves are shown for plioflex 1500, 1712, and 1006 vulcanizates in Figure 10. Table 2 lists the time required to absorb 1% oxygen for these vulcanizates. Examination of this table shows that vulcanizates containing up to 0.75-part of Wing-Stay 100 are approximatley equivalent to those containing 1.25 parts of PBNA. As the concentration of Wing-Stay 100 is increased above 1.0 part, the time to absorb 1% oxygen drops considerably. Thus, the data for the vulcanizates differ radically from corresponding polymer stabilization data in comparison with PBNA. Both sets of data agree, however, in the increase of the rate of oxygen absorption with an increase in concentration of Wing-Stay 100.

To get some idea as to the relative stability of various types of rubber vulcanizates samples of natural rubber and Plioflex 1500, 1712, and 1006 tread stocks were tested for oxygen absorption at 90° C. Table 3 lists the times to absorb 1% oxygen for these tread stocks. The data show that natural rubber stocks are more than twice as active toward oxygen as Plioflex 1712 stocks. The last are approximately twice as active as 1500 and 1006 stocks.

The same vulcanizates were evaluated by the creep test (16).[3] Creep curves are shown in Figure 11 for Plioflex 1500 (*top*), 1712 (*middle*), and 1006 (*bottom*). In Table 4 are listed the times to a given % creep for each vulcanizate. The rating by creep is much different than by oxygen absorption. In 1500 and 1006 vulcanizates practically all concentrations of Wing-Stay 100 are superior to 1.25 PBNA. In 1712 all concentrations of Wing-Stay 100 have higher creep rates than 1.25 parts of PBNA with the lowest creep rates being obtained at the higher concentrations of Wing-Stay 100.

The data show that oxygen absorption and creep do not agree in the rating of SBR vulcanizates protected with different quantities of Wing-Stay 100. To check further the data small dumbbell samples from six- by six- by 0.025-inch sheets were aged for seven and sixteen hours in the air bomb at 120° C. Elongation and tensile at break of the unaged and aged samples were determined. Only the results for the 16-hour air-bomb aging are reported.

Table 5 gives the data for Plioflex 1500, 1712, and 1006. In general, for 1500 and 1006 vulcanizates the retained tensile and elongation are slightly higher for stocks containing Wing-Stay 100 than for stocks containing PBNA. More important, there is no marked decrease of physical properties with increased amounts of Wing-Stay 100, as might have been predicted from oxygen absorption measurements. As in most previous tests 1712 gives different results than 1500 or 1006.

[1] Presented before the Division of Rubber Chemistry, ACS, Chicago, Ill., Sept. 11, 1958. Contribution #234 from the Goodyear research laboratory.
[2] See our Mar., 1959, issue, p. 863.
[3] *Ibid.*, p. 868.

TABLE 2. HOURS REQUIRED TO ABSORB 1.0% OXYGEN BY SBR VULCANIZATES

	SBR	1500	1712	1006
	Temp. °C.	100	90	100
Antioxidant				
1.25 PBNA		78	90	116
0.5 Wing-Stay 100		75	115	120
0.75 Wing-Stay 100		67	102	107
1.0 Wing-Stay 100		46	98	102
2.0 Wing-Stay 100		50	80	67
3.0 Wing-Stay 100		45	62	58
4.0 Wing-Stay 100		35	52	62

TABLE 3. COMPARATIVE OXIDATION RATES OF NATURAL AND SYNTHETIC RUBBER VULCANIZATES DETERMINED BY OXYGEN ABSORPTION AT 90° C. EXPRESSED AS HOURS TO ABSORB 1.0% OXYGEN

	Natural Rubber	SBR 1712	SBR 1500	SBR 1006
Antioxidant				
1.0 PBNA	30	—	—	—
1.0 Wing-Stay 100	38	—	—	—
1.25 PBNA	—	125	266	234
0.75 Wing-Stay 100	—	140	216	215
3.0 Wing-Stay 100	—	75	146	130

TABLE 4. COMPARATIVE CREEP DATA FOR THE SBR VULCANIZATES

	SBR 1500	1712	1006
	Temp. °C. 130	120	130
	Hrs. to % Creep 15	60	20
Antioxidant			
1.25 PBNA	20	27	15
0.5 Wing-Stay 100	28	8	39
0.75 Wing-Stay 100	33	13	>48
1.0 Wing-Stay 100	33	19.5	46
2.0 Wing-Stay 100	23	19	21
3.0 Wing-Stay 100	23	—	19
4.0 Wing-Stay 100	12	16	15

TABLE 5. AIR BOMB AGING (16 HOURS) @ 120° C.

SBR Vulcanizates—% Tensile and Elongation Retained

	Tensile, Psi.			Elongation, %		
	Orig.	Aged	% Retnd.	Orig.	Aged	% Retnd.
SBR 1500						
1.25 PBNA	4187	3472	83	423	317	75
0.5 W-S 100	4575	3712	81	427	327	77
0.75 W-S 100	4683	3943	84	422	327	78
1.0 W-S 100	4747	3740	79	430	322	75
2.0 W-S 100	4573	3840	80	445	370	83
3.0 W-S 100	4451	3649	82	442	357	81
4.0 W-S 100	4475	3362	75	430	387	90
SBR 1712						
1.25 PBNA	3263	2393	73	672	557	83
0.5 W-S 100	2630	1724	65	758	663	87
0.75 W-S 100	3121	1923	61	740	600	81
1.0 W-S 100	3114	2196	71	712	613	86
2.0 W-S 100	3116	1926	60	662	595	90
3.0 W-S 100	3082	1639	53	710	590	83
4.0 W-S 100	3205	1696	53	680	590	86
SBR 1006						
1.25 PBNA	3362	2864	85	395	343	87
0.5 W-S 100	3264	3312	101	380	340	89
0.75 W-S 100	3586	3297	92	397	323	82
1.0 W-S 100	3434	3425	100	390	342	88
2.0 W-S 100	3551	3246	91	410	357	87
3.0 W-S 100	3108	3348	108	375	383	102
4.0 W-S 100	3557	3264	92	410	400	98

TABLE 6. PHYSICAL PROPERTIES OF SBR 1500 TREAD STOCK AFTER UNDERGOING THE CREEP TEST

	Tensile, Psi.			Elongation, %		
Antioxidant	Orig.	Aged	% Retnd.	Orig.	Aged	% Retnd.
1.25 PBNA	4187	1168	28	423	60	14
0.5 W-S 100	4574	1633	36	427	122	29
0.75 W-S 100	4683	1891	40	422	127	30
1.0 W-S 100	4747	1842	39	430	130	30
2.0 W-S 100	4573	1631	36	445	117	26
3.0 W-S 100	4451	1615	36	442	113	26
4.0 W-S 100	4475	1794	40	430	108	25

For 1712 only 1.0 part of Wing-Stay 100 is approximately equivalent to 1.25 parts PBNA in tensile retention. On the other hand, the elongation of 1712 stocks containing Wing-Stay 100 is better than stocks containing PBNA.

Comparison of Test Results

Examination of the air-bomb aging data shows that the results agree more closely with creep than with oxygen absorption. However, Wing-Stay 100 in Plioflex 1500 and 1006 does not show the superiority in the air-bomb aging that it does in the creep test. This condition might be explained by the greater rigor of the creep test.

To test this postulation the tensile and elongation of Plioflex 1500 bands were determined after undergoing the creep test. Results are shown in Table 6. The aver-

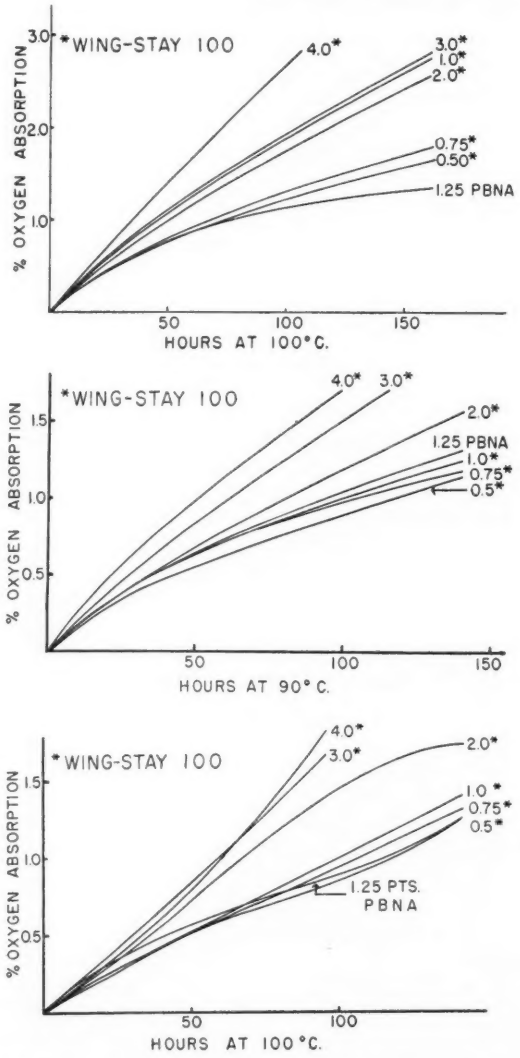

Fig. 10. Oxygen absorption at 100° C. on SBR vulcanizates containing various amounts of Wing-Stay 100 cured 90 minutes at 285° F.: *top*, Plioflex 1500; *middle*, Plioflex 1712; *bottom*, Plioflex 1006

age tensile of the creep bands containing Wing-Stay 100 after the creep test was 1,738 psi., compared to 3,708 psi. (Table 5) for the dumbbells after 16 hours' air-bomb aging. The average elongation after creep was 119%, compared to 340% (Table 5) after air-bomb aging.

It would appear that oxygen absorption, unless accompanied by measurements of physical properties, is a poor tool to use for vulcanizates containing substituted p-phenylenediamines as antiozonants, particularly at high concentrations. Shelton and coworkers (7-9) have pointed out that each antioxidant has an optimum concentration at which it is most effective. They also showed the unusual behavior of di-secondary butyl-p-phenylenediamine in accelerating the oxidation of rubber vulcanizates and mentioned that these samples had not deteriorated physically to the extent expected from the amount of absorbed oxygen. Data in the present paper would suggest that much of the increase in the oxygen absorption may be due to direct attack of oxygen on the antioxidant. This would indicate that stability of the polymers containing Wing-Stay 100 reported in the first part of this paper is better than oxygen absorption would indicate.

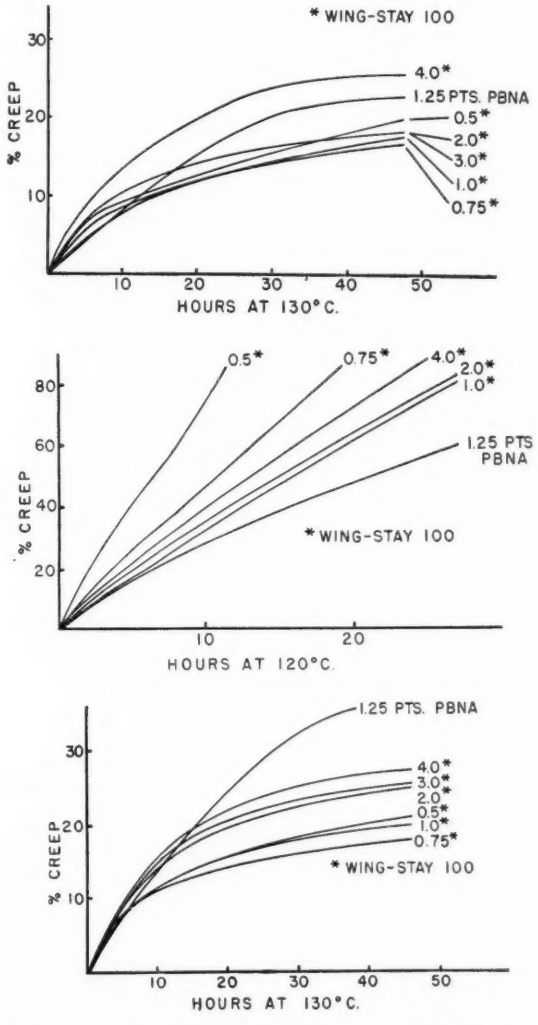

Fig. 11. % creep of SBR vulcanizates cured 90 minutes at 285° F. of antioxidants: *top*, SBR 1500 at 130° C.; *middle*, SBR 1712 at 120° C.; *bottom*, SBR 1006 at 130° C.

TABLE 7. COMPARISON OF WING-STAY 100 AND PBNA AS METAL DEACTIVATORS IN SBR 1006 AND 1712 CONTAINING 0.003% ADDED IRON AND EXPRESSED IN HOURS TO ABSORB 1.0% OXYGEN

	Without Added Iron		With Added Iron	
SBR 1006 (90° C.)	Hrs.	% Improvement over PBNA	Hrs.	% Improvement over PBNA
1.25 PBNA	114	—	73	—
0.5 W-S 100	364	219	256	252
0.75 W-S 100	455	300	327	348
1.0 W-S 100	480	321	382	423
2.0 W-S 100	350	207	327	348
3.0 W-S 100	260	128	265	263
4.0 W-S 100	204	79	212	190
SBR 1712 (80° C.)				
1.25 PBNA	29	—	36	—
0.5 W-S 100	48	65	72	100
1.0 W-S 100	55	89	91	155
2.0 W-S 100	77	165	112	211
3.0 W-S 100	84	190	125	247
4.0 W-S 100	84	190	118	228

TABLE 8. COMPARISON OF WING-STAY 100 AND PBNA AS METAL DEACTIVATORS IN SBR TREAD STOCK CONTAINING 0.003% ADDED IRON. DETERMINED BY CREEP TEST RUN AT 130° C. ON STOCK CURED 90 MINUTES AT 285° F. WITH RESULTS EXPRESSED IN HOURS TO REACH 20% CREEP

SBR 1006	Without Added Iron	With Added Iron
1.25 PBNA	13	7
0.5 W-S 100	29	44
1.0 W-S 100	35	56 (ext.)

TABLE 9. PHYSICAL PROPERTIES OF SBR 1006 TREAD STOCK SAMPLES AFTER CREEP TEST

	Tensile, Psi.		Elongation, %	
	Without Iron	With Iron	Without Iron	With Iron
1.25 PBNA	1061	854	43	25
0.5 W-S 100	1331	1336	113	104
1.0 W-S 100	1275	1321	120	115

In the case of Plioflex 1712 polymers and vulcanizates, another variable is encountered: namely, the oxidation of the oil. The % oxygen absorbed is based on the rubber hydrocarbon content only; any oxygen absorbed by the oil is counted against the 1712 rubber. Figure 12 shows the oxygen absorption of Dutrex 8

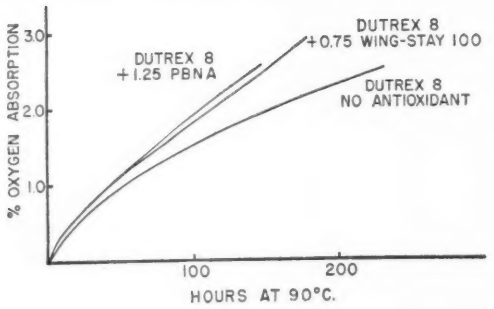

Fig. 12. Oxygen absorption of Dutrex 8 extender oil with and without antioxidants at 90° C.

at 90° C. with and without antioxidant. The curves show that Dutrex 8 absorbs 1% oxygen in approximately 50 hours, and that neither PBNA nor Wing-Stay 100 inhibits the oxidation of the oil. Furthermore, the effects of the oxidized products of the oil on the oxidation of the rubber are unknown.

To summarize, Wing-Stay 100 is an effective antioxidant for SBR vulcanizates. Use of amounts in excess of 1.0 part for antiozonant purposes, in general, are not harmful to its antioxidant properties.

Metal Deactivation

Wing-Stay 100 has metal deactivating properties. For all deactivating studies 0.003% iron as anhydrous ferric chloride was added on the basis of rubber hydrocarbon. In the case of polymers, oxygen absorption was measured as usual. For Plioflex 1006 tread stock, creep was determined, followed by measurement of elongation and tensile of the creep samples.

Plioflex 1006 is the best polymer in which to show metal deactivation because it is practically an iron-free polymer. Oxygen absorption curves for 1006 containing iron are shown in Figure 13 (*top*). Essential data are summarized in Table 7. Examination of this table shows that the addition of ferric chloride has increased the rate of oxygen absorption in all cases; it has, however, increased the rate much more for polymers containing PBNA than for polymers containing Wing-Stay 100.

Oxygen absorption curves of Plioflex 1712 polymer containing added iron are shown in Figure 13 (*bottom*). In Table 7 the times required to absorb 1% oxygen with and without added iron are tabulated. Examination of the table shows several interesting things. All samples containing added iron have slower rates of oxygen absorption than those with no added iron. This has been checked several times with the same results. As with 1006 polymer, samples of 1712 containing Wing-Stay 100 and iron are considerably more stable than the corresponding PBNA polymer, as evidenced by the last column, expressing % improvement over PBNA.

Metal deactivation is particularly difficult to show in sulfur cured stocks because most of the iron is thought to be converted to the inactive sulfide. It has been found that creep is quite sensitive to metals. Creep

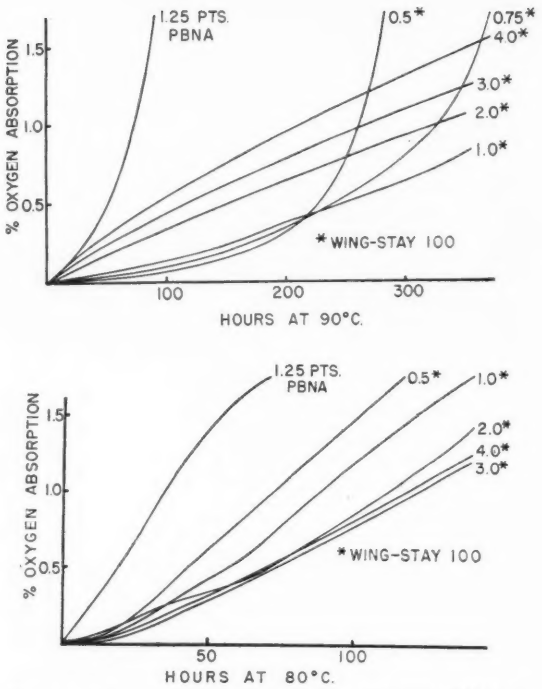

Fig. 13. Comparison of Wing-Stay 100 and PBNA as metal deactivators in SBR polymers containing 0.003% added iron: *top*, SBR 1006; *bottom*, SBR 1712

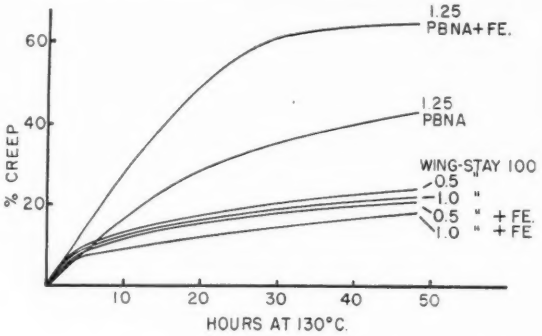

Fig. 14. Comparison of Wing-Stay 100 and PBNA as metal deactivators in SBR 1006 tread stock containing 0.003% added iron; determined by creep test run at 130° C. on stock cured 90 minutes at 285° F.

curves for 1006 black vulcanizates are shown in Figure 14. The hours required for 20% creep are listed in Table 8. After creep the samples were measured for retained tensile and elongation. Data are listed in Table 9 for samples with and without iron. All these data show the positive action of Wing-Stay 100 as a metal deactivator.

Wing-Stay 100 as Antiozonant

Wing-Stay 100 is an antiozonant for SBR tread stocks. A second publication on the antiozonant and weathering properties of Wing-Stay 100 is planned for the ozone symposium at the Los Angeles meeting of

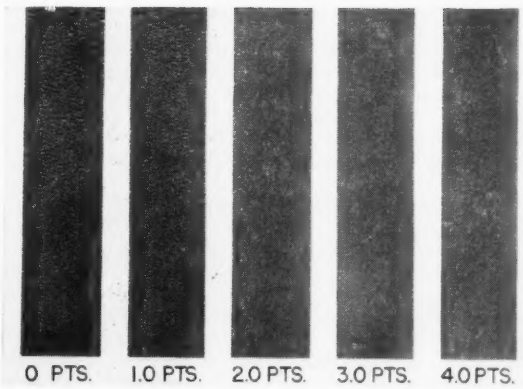

Fig. 15. Effect of concentration of Wing-Stay 100 on dynamic ozone resistance of SBR (Plioflex) 1712 vulcanizates exposed to 55 pphm. ozone at 100° F. for 50 hours

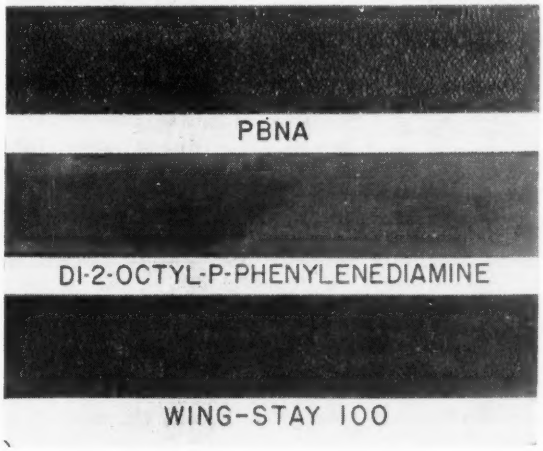

Fig. 16. Dynamic ozone resistance of unaged SBR (Plioflex) 1712 vulcanizates exposed to 55 pphm. ozone at 100° F. for 48 hours

the Division of Rubber Chemistry, ACS, May, 1959. Only a few pertinent facts will be given in this paper.

The testing to be reported was done in a Mast ozone chamber, Model No. 644-2.[4] Dynamic testing was carried out at an ozone concentration of 53-57 pphm. and at 100° F. Samples were stretched at 80 cycles per minute between 0 and 10% elongation.

The effects of concentration of Wing-Stay 100 upon its antiozonant properties are shown for Plioflex 1712 vulcanizates. The formulation is given in Table 1. Results after 50 hours' exposure in the ozone chamber are shown in Figure 15. These samples show that while 1.0 part of Wing-Stay 100 gives some protection against ozone, at least, two to three parts are needed for maximum ozone protection.

Effects of preaging on ozone resistance can be demonstrated by aging samples before dynamic exposure in the ozone chamber. To check this factor, oil-extended black stocks were compounded using 2.5 parts of PBNA, Wing-Stay 100, and di-2-octyl-p-phenylenediamine. One group of samples was aged 48 hours at 212° F. before exposure, and the other group was unaged. Figure 16 shows the unaged samples after 48 hours' exposure in the Mast chamber. Di-2-octyl-p-phenylenediamine is better than Wing-Stay 100 in this test. In Figure 17 the corresponding aged samples are shown. After preaging, Wing-Stay 100 is superior to di-2-octyl-p-phenylenediamine.

[4] Mast Development Co., Inc., Davenport, Iowa.

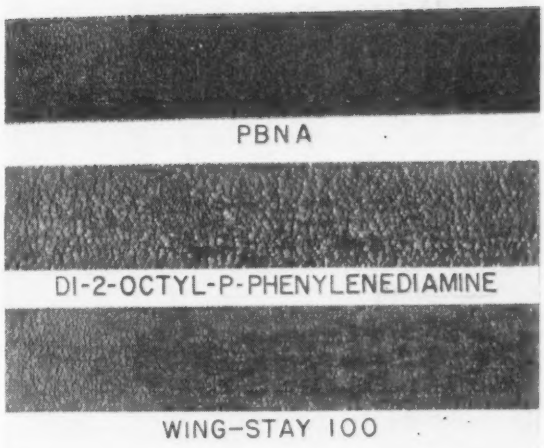

Fig. 17. Dynamic ozone resistance of SBR (Plioflex) 1712 vulcanizates preaged 48 hours at 212° F. and then exposed to 55 pphm. ozone at 100° F. for 48 hours

This reversal upon preaging can be explained by the greater volatility of di-2-octyl-p-phenylenediamine and/or its greater activity with oxygen. Previous data have shown that di-2-octyl-p-phenylenediamine is three times as volatile as Wing-Stay 100 and approximately 12 times more active toward oxygen.

Conclusion

Wing-Stay 100 is a mixed diaryl-p-phenylenediamine. It may act four ways to increase the useful life of rubber—as an antioxidant, as an antiflex cracking agent, as a metal deactivator, and as an antiozonant.

Wing-Stay 100 is more soluble in rubber and is less staining than present commercially available disubstituted-p-phenylenediamine antiozonants owing to its lower volatility. In addition, Wing-Stay 100 has very little effect on the rate of cure.

Acknowledgment

The authors wish to express their appreciation to the Goodyear Tire & Rubber Co., to H. J. Osterhof, director of research, and to A. M. Clifford, manager, chemicals and plastics, for permission to publish this paper. The authors would also like to thank the many members of the research and development departments who have contributed to the collection of data used in this publication.

MEETINGS and REPORTS

Fine Program Completed For Rubber Division at L.A.

A technical program of exceptional merit, plant trips of special interest, and an opportunity to see some of the features of the "City with a Future" are in store for those attending the meeting of the Division of Rubber Chemistry, American Chemical Society, in Los Angeles, Calif., May 13-15. The headquarters hotel will be the Biltmore, but the local committee has scheduled the Divisional banquet on Thursday evening, May 14, at the Beverly Hilton Hotel in nearby Beverly Hills, where the cuisine, service, and entertainment will make this an event long to be remembered, it is said.

The technical program will include a symposium on "The Effect of Ozone on Rubber," which comprises a session of contributed papers on the afternoon of May 13 and a session of invited papers on the morning of May 14. Another symposium of invited papers on "Urethane Foams and Elastomers" will be held also on the afternoon of May 13. In addition to these symposia on subjects of very great current interest, there will be two sessions on the morning of May 15, one on new rubbers and new information on rubbers not so new, and the other on vulcanization and some of the latest findings and techniques on this process which is the cornerstone of the rubber products industry.

On Thursday afternoon, May 14, registrants will have a choice of a visit to a Douglas Aircraft Co. assembly plant for DC-8 jet airliners or to a styrene-butadiene synthetic rubber producing plant.

The usual luncheon meeting of the Division's 25-Year Club will be held on May 13, at the Biltmore Hotel. E. G. Partridge, University of Southern California and Tlargi Rubber Technology Foundation director, will preside.

E. H. Krismann, E. I. du Pont de Nemours & Co., Inc., Division chairman, will preside at the opening of the technical sessions on Wednesday afternoon, at the business meeting on Thursday morning, and at the banquet on Thursday evening. W. J. Sparks, Esso Research & Engineering Co., Division vice chairman, will preside at the alternate session on Wednesday afternoon; G. T. Gmitter, General Tire & Rubber Co., will take over from Mr. Krismann for the symposium on "Urethane Foams and Elastomers"; H. A. Winkelmann, Dryden Rubber Division, Sheller Mfg. Corp., will conduct the Thursday morning session; A. J. Hawkins, Du Pont, and B. R. Snyder, R. T. Vanderbilt Co., cochairman of the local committee, will preside at the two sessions on Friday morning.

An award for the best paper at the Division's Chicago 1958 meeting will be made to T. C. Williams, R. A. Pike, and F. Fekete, Silicones Division, Union Carbide Corp., for their paper "Cyanol-silicone Elastomers—A new class of Solvent-Resistant, High-Temperature Rubbers." The presentation will be made at the banquet on the evening of May 14.

The Division's executive committee will meet on Tuesday, May 12, and again on the morning of May 13. There will be the usual luncheon-meeting with the officers of the local rubber groups on Friday noon, May 15.

The local committee has made special arrangements for ladies attending this meeting, in the form of a guided tour of Disneyland culminating in a fashion show at the Disneyland Hotel. For those, (both husbands and wives) who might be combining a vacation trip with the meeting, there is a scheduled trip to the Hawaiian Islands, to follow the formal program.

The City of Los Angeles

A few facts and figures about Los Angeles which might be of interest include its population, which in 1957 totaled 5,880,000, its area of 454 square miles, its 11 accredited colleges and universities, the movie making capitol, Hollywood, within its borders, and the major radio and television studios.

Then there is Olvera Street, a bit of Old Mexico; Chinatown, with its quaint shops; Grauman's Chinese Theater, a landmark on Hollywood Boulevard; and for those interested in a different variety of stars, Griffith Park Observatory. The fabulous new Disneyland provides everyone with something of interest.

The 1954 Census of Manufactures rated Los Angeles as the nation's third ranking industrial area. A recent survey by the Los Angeles Chamber of Commerce showed the aviation industry led a field of 19 major industries in capital investment, with automotive industry second, metal products firms third, electronics fourth, chemicals and paints fifth, and petroleum sixth. The Los Angeles Metropolitan Area is second, nationally, in automobile tire and tube production.

Program and Abstracts of Papers

Wednesday Afternoon — May 13
Symposium on Urethane Foams and Elastomers
Invited Papers
G. T. Gmitter, Presiding

2:00 p.m.-1. Introductory Remarks. E. H. Krismann, Division Chairman.

2:10 p.m.-2A. Urethane Polyether Prepolymers and Foams—Influence of Chemical and Physical Variables on Reaction Behavior. H. G. Scholten, **J. G. Schuhmann,**[1] R. E. TenHoor, The Dow Chemical Co., Midland, Mich.

For several years the principal guides for process control of urethane polyether prepolymer manufacture have been time, temperature, viscosity, and excess isocyanate content. These tools have not been adequate, and extensive investigation has now defined the "CPR" relationship, probably the single most critical factor influencing prepolymer processing and foam characteristics. The controlled polymerization rate factor is calculated from data based on a group of accurate and reproducible analytical tests applied to the polyglycol and diisocyanate raw materials. Polymerization character is defined by a constant viscosity/temperature monitoring device and other instrumentation techniques. This total data provides a technological framework of useful tools for producing specific prepolymers and foams.

Improper control of the factors making up the "CPR" relationship can lead to gelation or inadequate linear and/or branching polymerization. In addition, cell collapse, heat or humidity degradation, and/or inadequacy in physical properties of the foam can result even though certain adjustments are possible, though with less definition

[1]Author's name in bold face indicates person delivering paper.

and control, at the foam head phase of the operation.

The influence of the "CPR" factor on the polyether diols *versus* triols and on polyethers having secondary *versus* primary hydroxyls is described. Furthermore, the ramifications of these variables in "one-shot" polyether systems are explored.

The influence of the physical variables of prepolymer processing equipment is outlined and reliable extrapolation from a few key checkpoints appears practical from 200 grams to 2000 gallon batches. More difficultly controllable conditions surround the foaming operation with each foam machine of individualistic temperament. More latitude is permissible, however, in foam processing than in the highly critical prepolymer stage where trace quantities of impurities must be balanced quantitatively.

2:35 p.m.-3A. One-Shot Foaming of Polyether-Polyurethanes with Organometallic Tin Compounds. F. Hostettler and E. F. Cox, Union Carbide Chemicals Co., South Charleston, W. Va.

In the manufacture of flexible polyurethane foams two processes are of commercial importance. The so-called one-shot process is applied particularly with the polyesters and consists of mixing the foamants simultaneously in the mixing-head, and the foam is formed in one step. With polyethers, this process has only recently been made possible by the introduction of more active catalysts. In general, polyether intermediates possess low viscosity, and most products contain predominantly secondary hydroxyl groups, consequently exhibiting lesser reactivity than polyesters which have primary hydroxyl groups. To overcome slow reactivity and low viscosity, the prepolymer process which consists of prereacting polyethers with diisocyanates to form high-viscosity prepolymers having isocyanate end-groups was introduced several years ago. The prepolymer is converted to foams by admixing catalyst, surfactant and water. Fundamental studies of new isocyanate catalysts in our laboratory have led to the discovery of many extremely effective catalyst systems which enable one-step foaming of polyethers.

Based on our discovery that certain organometallic compounds accelerate the reaction of isocyanates with compounds containing an active hydrogen atom more efficiently than tertiary amines, several hundred compounds were compared as catalysts. The reaction of phenyl isocyanate with butanol in dioxane as the solvent at 70° C. served as a model reaction for the comparison of catalysts.

Organometallic compounds of tin, that is, compounds containing at least one carbon to tin bond, are particularly outstanding as isocyanate catalysts. Within the tin series, dialkyltin compounds are particularly effective.

In order to obtain a measure of the performance of the novel catalysts in foaming reactions a second series of model reactions was conducted wherein phenyl isocyanate was reacted with butanol (chain extension reaction), water (foaming reaction) and diphenylurea (cross-linking reaction). It was observed that the relative ratio of the reaction rates of the phenyl isocyanate with butanol *versus* the rate of the phenyl isocyanate reaction with water is high in the case of organometallic tin catalysts, but relatvely low in the case of tertiary amines. This means that in one-shot processes the tin catalysts are capable of substantial polymer formation before gas evolution becomes rapid; whereas with tertiary amine catalysts the gas evolution is too rapid in relation to the polymer foaming reaction resulting in partial foam collapse.

During the experimental foaming work it was observed that catalyst combination systems of tin compounds of the type referred to above and tertiary amines lead to more rapid foaming and curing than tin catalyst systems by themselves. Careful examination of this phenomenon by means of rate studies proved this to be a synergistic effect. Depending on the tin compound, the three reactions of importance in the foaming process can be accelerated over and above the rates observed with tin compounds alone by a factor of from two to five by addition of small amounts of tertiary amines. The chemical structure of the tertiary amine seems to have little influence upon the synergistic effect.

The above discovery of the high activity of the organometallic tin compounds made possible the development of a one-shot process for foaming polyether intermediates based on propylene oxide. Surfactant systems consisting of polyoxalkylene-polydimethylsiloxane block-copolymers are essential for successful foaming operation. Foam formulations with various polyether systems will be presented, and the effect of different variables on foam properties will be discussed.

Aging properties of one-shot polyether foams prepared by tin catalysis are now being investigated. At temperatures above 100° C. oxidative degradation of foams catalyzed by some tin compounds is observed. This can be overcome to a substantial extent by addition of antioxidants. Long-term lower-temperature exposure studies of such foams are needed to predict the performance of foams in actual use.

3:00 p.m.-4A. Some Properties and Applications of Loaded Flexible Urethane Foams. S. J. Assony and S. Chess, American Latex Products Corp., Hawthorne, Calif.

Flexible polyesterurethane foams in general exhibit a marked plateau in their stress-strain curves ("bottoming effect"), do not possess a quick return, are not readily moldable, and are not easily obtained in higher densities. These limitations preclude the use of polyesterurethane foams from many applications wherein their otherwise desirable properties might be utilized to advantage. Incorporation of suitable reinforcing fillers into the foam reduces or eliminates the bottoming effect and imparts a rubber-like quick return. Other physical properties are also improved. Loaded flexible urethane foams are readily moldable in inexpensive tooling, forming a skin which accurately reproduces the mold finish. Obtainable densities range from 8 to 80 pounds per cubic foot.

Loaded foams in molded form and sheet stock are finding useful applications in assemblies wherein oil, oxygen, ozone, and fatigue resistance are important factors. Since the physical properties of these foams can be varied within rather broad limits, they are also utilized in specialty applications for which no previously known single material has been suitable.

3:25 p.m.-5A. The Mechanism of the Water Reaction with Isocyanates. G. Shkapenko, **G. T. Gmitter,** E. E. Gruber, General Tire, Akron, O.

The reaction of water with isocyanates plays an essential part in the foaming of urethanes. Besides providing the carbon dioxide necessary for blowing, this reaction serves to provide chain extension and cross-linking in the polymer phase.

To clarify the nature of this reaction, the hydrolysis of simple isocyanates was studied in the presence of tertiary amine catalysts. The reactions were followed by measurements of the rate of isocyanate functionality consumption as well as by the rate of carbon dioxide evolution. Greatest emphasis was placed on the study of the reaction involving water and ortho tolyl isocyanate.

This reaction is quite complex, and reaction intermediates and patterns will be discussed in the light of this study. The first product formed in the reaction of water with ortho tolyl isocyanate is the substituted carbamic acid. In addition to the decomposition of this carbamic acid to form ortho toluidine and carbon dioxide, the carbamic acid reacts with isocyanate to form some 35% of the carbamic acid anhydride. The ortho toluidine formed in the carbamic acid decomposition not only reacts with additional isocyanate to form the urea derivative, but also reacts with some of the undecomposed carbamic acid to form the 4-5% of the amine salt of this acid.

The reaction of this isocyanate with ortho tolyl urea proceeds at an appreciable rate to form the biuret. Such reaction undoubtedly has a significant role in the total hydrolysis reaction.

The overall water reaction with isocyanates is discussed in view of these intermediates established by this study.

3:50 p.m.-6A. "Chemical Compounding" of Liquid Urethane Elastomers.[2] **R. J. Athey,** Du Pont, Wilmington, Del.

Liquid urethane elastomers are well suited for the preparation of very hard vulcanizates which combine hardness with resilience, toughness, and oil and abrasion resistance. They are of interest to elastomer product manufacturers because of the wide variety of mechanical properties obtainable which allows unusual product design.

A family of elastomers is obtained through chemical modification of the polymer structure. This paper discusses the effect of compounding and processing variables on the mechanical properties of the vulcanizate. A systematic study of curing temperature, the amount of curing agent, the use of added diisocyanate, and the molecular weight of the liquid polymer is reported. These data have been treated statistically, and the design of urethane compounds for specific applications has been simplified.

These studies have yielded unusually hard vulcanizates which approach the properties of plastic resins, but exhibit resilience, impact strength, and excellent resistance to low-temperature embrittlement characteristic of elastomers.

4:15 p.m.-7A. The Development of Cast Urethane Elastomers for Ultimate Properties. K. A. Pigott, **B. F. Frye,** K. R. Allen, Samuel Steingiser, W. C. Darr, J. H. Saunders, E. E. Hardy, Mobay Chemical Co., New Martinsville, W. Va.

The past history of polyester-based polyurethane elastomers has been concerned mainly with developing an elastomer with properties that were optimum in all respects. Little has been reported on how to vary molecular structure to improve specific physical properties, such as low-temperature flexibility and high-temperature resistance, load bearing, etc. This research is being conducted to develop a better working knowledge of the effect of changes in molecular components and types of cross-linking on the ultimate physical properties of the polyester urethane elastomers.

Three groups of materials can be varied to produce changes in the final product: polyester, diisocyanate, and chain extender. By varying the component parts of the polyester (i.e., the dibasic acid and the dihydroxy compound), the cured material can be a hard, semi-plastic material, a soft elastomer, or anything in between. By changing the diisocyanate used (and the quantity used), a wide range of hardnesses, moduli, and tear strengths can be obtained. The chain extenders fall into two sub-groups: (1) difunctional; and (2) tri- or polyfunctional. When aliphatic glycols up to six carbons in length are used, little change in physical properties are noted. With alkylaryl glycols, however, substantial changes are noted when the molecular structure of the glycol is modified. With trihydroxy compounds, the physical properties change as the percentage of the polyhydroxy compound used increases.

In all of this work, the goal has been to interpret the changes in physical properties as a function of the intermolecular forces involved, the type and the extent of chemical cross-linking that is present. By using these guides it is now beginning to be possible to develop elastomers which are truly "tailor made" for specific end-applications.

[2]Contribution No. 151 of the Du Pont elastomers laboratory.

Wednesday Afternoon—May 13
Symposium on Effect of Ozone on Rubber
Contributed Papers
W. J. Sparks, Presiding

2:00 p.m.-2B. Compounding Variables Affecting Antiozonant Requirements. William L. Cox, Universal Oil Products Co., Des Plaines, Ill.

Previous studies of the effect of compounding variables on the antiozonant requirements of typical compounds have been extended to include the effect of processing and extending oils, the SBR/NR ratio in mixed polymers, and the effect of the wax selected for testing antiozonant-wax combinations.

The data reveal only a slight increase in antiozonant requirement when the process oil concentration in an SBR tire sidewall formulation is varied from 0-10 phr. However, with SBR stocks based on carbon black masterbatches, both cabinet and outdoor tests show a 50% increase in the antiozonant requirement of an oil-extended polymer over that of the oil-free material.

Work with SBR/NR blends shows no significant increase in the concentration of N,N'-dioctyl-p-phenylenediamines needed to protect stocks containing 0-20% NR.

The antiozonant-wax studies indicate the potential error in comparing as antiozonants even somewhat similar compounds in wax-containing stocks. Waxes differ so widely in their "compatibility" with antiozonants that through an improper selection of the wax used in comparative studies erroneous generalizations as to the relative merits of antiozonants under consideration may be reached.

2:20 p.m.-3B. The Ozone Resistance of Styrene-Butadiene Rubber at Low Temperatures. Richard F. Grossman and Allen C. Bluestein, research laboratories, Anaconda Wire & Cable Co., Marion, Ind.

There has been an increasing use of styrene-butadiene rubber vulcanizates for extreme low-temperature service where resistance to weathering and/or abnormally high concentrations of ozone is required. Very little work has been reported on the effect of low temperature on ozone resistance of such vulcanizates.

The resistance of SBR vulcanizates to ozone degradation is reported over the 20 to —60° C. temperature range in this paper. Samples ozonized under high physical stress are found to have ozone failure times independent of ambient temperature. At low applied stress a marked temperature dependence is observed above a critical temperature typical of the stress involved. At temperatures below this value, the time required for ozone cracking to occur approaches infinity at ozone concentrations below 0.10%.

This discontinuity greatly exceeds the loss in reaction velocity with decreasing temperature predicted by simple kinetic considerations. Its occurrence is interpreted as a shift from ozonide formation to ozonide decomposition as the rate determining step in the ozone degradation process. The decomposition of the rubber ozonide is subject to two influencing factors: temperature and applied physical stress. The experimental data are correlated with the instability of the ozonide at high applied stress, and above a critical temperature.

The results of this study imply that under low stress the ozone resistance of SBR at low temperature is far superior to what would normally be predicted.

2:40 p.m.-4B. A Method of Screening Antiozonants. F. A. V. Sullivan and Arnold R. Davis, American Cyanamid Co., Bound Brook, N. J.

A method has been developed for screening organic compounds for testing them as antiozonants in rubber. The method is based upon the determination of the ability of the compounds to suppress the reaction of ozone with a model unsaturated hydrocarbon, cyclohexene. The compound being tested is dissolved in a solvent inert toward ozone, carbon tetrachloride, together with excess cyclohexene, and the solution subjected to a stream of ozonized air for a period of time. The ability of the compound to suppress the reaction of ozone with cyclohexene is determined by measuring the rate at which ozone is consumed in the reaction. The rate at which ozone is consumed is determined by analyzing the effluent air stream for changes in oxygen concentration, equivalent to ozone, by means of a Beckman oxygen analyzer.

The reactivity of a number of compounds evaluated by this method is compared to the reactivity of a known antiozonant which is used as a reference standard.

3:00 p.m.-5B. Correlation of Ozone Chamber and Outdoor Exposure. H. A. Winkelmann, Dryden Rubber Division, Chicago, Ill.

Observations on the effect of outdoor exposures on styrene-butadiene rubber vulcanizates were started in April, 1952, and have been continued up to the present. Comparisons are made with exposures in the ozone chamber, using 25 parts ozone per 100 million parts of air at 100° F. A 50 hardness extruded SBR compound was used in this study. A masterbatch without sulfur, accelerator, or wax was mixed in a Banbury. Sulfur, accelerator, and various chemicals were added on a laboratory mill. Wax was added in a molten condition. Test strips were extruded through a triangular die. Samples were exposed on two-inch-diameter wooden mandrels and rated according to ASTM D 1171-57T, Method of Test for Weather Resistance of Automotive Rubber Compounds.

Ozone exposure tests correlate closely with short-time outdoor exposure tests. After six to seven years' exposure there is a greater degree of cracking than shown by the ozone chamber, however. It is noted that strips cut from one length of compound may show a rating of O (no cracking) in the ozone chamber and yet will give ratings of 1, 2, or 3 (cracking) on outdoor exposure. Conversely, in many instances, the ozone chamber gave a rating of 3; while outdoor exposures after seven years' exposure still show a rating of 0, 1, or 2.

To summarize, exposed samples may fail owing to other reasons than ozone cracking, and such failures seldom show up in the ozone chamber. These failures are splits, flow lines or flow cracks, due to poor flow or lack of knitting during processing of the stock. Poor dispersion may cause pits when pigment agglomerates drop out.

A sample that is satisfactory in the ozone chamber may fail on outdoor exposure for causes other than ozone cracking.

3:20 p.m.-6B. Comparative Performance of Antiozonants in Road and Accelerated Tests in the Los Angeles Area. Frank B. Smith, United States Rubber Co., Naugatuck Chemical Division, Naugatuck, Conn.

The comparative performance of several commercial antiozonants was studied in tires by means of road and accelerated tests in the Los Angeles area. The relative effectiveness of these chemicals *as antiozonants* is examined and discussed. Correlations are noted between the accelerated tests and actual tire performance, and conclusions drawn. The chemical, N-phenyl-N'-isopropyl-p-phenylene diamine, is shown to exert extremely powerful protection against ozone checking in the Los Angeles area.

The relative value of commercial antiozonants *as antioxidants* was also studied in laboratory tests and on the road in nylon heavy-duty tires. Truck tire performance in the Los Angeles area is contrasted with comparable commercial truck tire tests in Texas and in the Midwest. N-phenyl-N'-isopropyl p-phenylene diamine inhibits groove cracking in nylon heavy-duty tires by a factor of approximately 400%.

The dual protective value of N-phenyl-N'-isopropyl-p-phenylene diamine will be useful in extending the service life of passenger and truck tires.

3:40 p.m.-7B. Resistance of Rubber Compounds to Outdoor and Accelerated Ozone Attack II. G. N. Vacca, G. H. Bebbington, and R. E. Johnson, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Because of the limited study of natural rubber included in the first paper[3] it was felt that this area should be covered more extensively. A tire tread-type formulation was chosen as a base compound because in addition to its use in tires, it bears some resemblance to wire and cable jackets. In all, 18 waxes and 19 chemical additives were used in the work reported in this paper. Each wax and each chemical was used by itself in 1½ and 3 phr. concentration. One wax which had shown much promise in earlier work was then used in combination with each chemical in concentrations of 1½ wax, 1½ chemical, and 3 wax and 3 chemical. Of the 19 chemicals, six are generally recognized as antioxidants; while 13 are antiozonants.

All of the samples were prepared as press cured sheets. Specimens from the sheets were mounted on rods to give 30% stretch, and other specimens were mounted as bent loops per Method B, ASTM D 518-57T, Method of Test for Resistance to Surface Cracking of Stretched Rubber Compounds. One set of each type of specimen was placed in a Crabtree ozone chamber maintained at 25 pphm. ozone and 120° F. and a similar set was exposed outdoors at Los Angeles. Behavior of the specimens under these conditions will be studied.

Two synthetic natural rubbers were included in this work. In these cases one wax alone and in combination with one chemical was added.

The results of outdoor exposure up to six months in Los Angeles will be compared with results obtained in the ozone chamber.

4:00 p.m.-8B. Wing-Stay 100 as an Antiozonant. J. C. Ambelang and **B. W. Habeck,** Goodyear Tire & Rubber Co., Akron.

Wing-Stay 100, a stabilizer, antioxidant and flex crack inhibitor, was the subject of a paper presented by Spacht, Lichty, and Hollingshead[4] at the 1958 Chicago, Rubber Division, ACS, meeting. This mixed diaryl p-phenylene diamine is also an unusually persistent antiozonant and antiweathering agent for SBR polymers. The persistence of Wing-Stay 100 is attributable to its low volatility and low oxidation rate in comparison with other commonly used antiozonants of the dialkyl p-phenylene-diamine type.

Comparision in tread-type recipes containing paraffin indicate that three to four parts per 100 RHC of Wing-Stay 100 in SBR-1500, or four parts per 100 RHC in SBR-1712, result in excellent protection against static and kinetic exposure in either an ozone atmosphere or out-of-door's weathering

This new material was compared with various antiozonants in SBR-1500 and 1712 compounds. Data showed Wing-Stay 100 to be equal to, or somewhat less effective initially than the dialkyl-p-phenylene diamines in compounds exposed in ozone or to weather aging. However, when these same compounds were subjected to 48 hours aging at 212° F. before ozone or weather exposure, the Wing-Stay 100 protected stocks proved to be notably superior to those stocks containing dihydroquinoline or dialkyl-p-phenylene diamine antiozonants.

4:20 p.m.-9B. Accelerated Aging Tests and Outdoor Performance of Butyl Rubber. W. W. Gleason, **D. R. Hammel,** Enjay Laboratories, Linden, N. J.

An analysis has been made of results of aging tests conducted on 250 butyl rubber compounds. Compounding variables included a wide variety of filler systems, curing mechanisms, plasticizer types and loadings, and ozone protective systems. Data have been collected over a three-year period relating accelerated ozone tests to outdoor aging in Metropolitan New Jersey, California, and Florida. Correlation of results indicates that outdoor weathering performance can be predicted with a good degree of accuracy on a statistical basis.

The interrelated effects of compounding techniques, aging time, and conditions of exposure are discussed.

Thursday Morning—May 14
Symposium on Effect of Ozone on Rubber
Invited Papers
H. A. Winkelmann, Presiding

9:00 a.m.-10. The Operation of Ozone Chambers in Rubber Laboratories to Minimize Variation in Test Results. M. Lowman, Goodyear St. Marys Plant, St. Marys, O.

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[3] "Resistance of Rubber Compounds to Outdoor and Accelerated Ozone Attack." C. V. Lundberg, G. N. Vacca, and B. S. Biggs, RUBBER WORLD, 135, 699 (1957).

[4] *Ibid.*, Mar., 1959, p. 863; Apr., 1959, p. 81.

In static ozone testing of rubber vulcanizates there has been a very great variation in results between laboratories. Duplicate samples tested simultaneously in the same ozone test chamber showed variations in results from severe cracking to no cracking.

Working committees of the Society of Automotive Engineers' Technical Committee on Automotive Rubber and the American Society for Testing Materials Committee D-11 on Rubber were formed to investigate causes and try to develop means to reduce this variation. This paper reports the results of these programs.

On the compounds tested, it is now possible to have duplicate samples tested simultaneously in an ozone cabinet give duplicate results and a very high degree of reproducibility between laboratories. Changes made to secure better results were: (1) a complete change of air in the ozone test chamber every one minute twenty seconds or oftener; (2) a 72-hour rest period on the ASTM D 1171 method mandrel in an ozone-free atmosphere before placing in the ozone test chamber; (3) care in handling the specimens.

The timing of the preparation of the preform after mixing or before vulcanization is of very minor importance. The effect of injection molding, compression molding, and open-steam vulcanization on the ozone resistance of elastomers is given.

The ratings 0, 1, 2, and 3 of ASTM D 1171 were used in most of these investigations. These are visual examination tests. Data are given to show that an operator can duplicate ratings 91% of the time.

9:30 a.m.-11. Ozone Resistance of Rubber Insulations. W. H. Couch, **G. H. Hunt,** O. S. Pratt, Simplex Wire & Cable Co., Cambridge, Mass.

This investigation was undertaken in order to increase our understanding of the mechanism of ozone and corona cutting of rubber high-voltage cable insulation and to develop the compounding knowledge necessary to exploit the inherently stable polymer butyl rubber as the base for such an insulation.

It was found that the relaxation of mechanical stress plays a very important role in the behavior of compounds exposed to ozone, and studies were made to establish the stress decay characteristics of various formulations based on natural rubber, SBR, and butyl rubber. A method was developed for correlating the stress decay and ozone resistance characteristics which permits the performance of any formulation to be predicted at ozone concentrations up to 0.5%. Comparisons were made between the cutting in an intense corona discharge and that in high concentrations of ozone outside of the discharge. Predictions based on these studies correlate well with results of accelerated tests in corona discharge.

Tests were carried out in the products of corona discharge at pressures less than atmospheric. These tests lead to the conclusion that at very low pressures (ca. one mm. Hg) cutting is caused not by ozone, but by atomic oxygen. Compounds based on a variety of polymers were exposed to atomic oxygen, and some indications of their resistance to cutting were obtained.

10:00 a.m.-12. Weather Aging of Elastomers on Military Vehicles. W. D. England, J. A. Krimian, R. H. Heinrich, Detroit Arsenal, Detroit, Mich.

Prevention of ozone cracking of rubber is one of the more serious and important problems which confronts the Ordnance Corps. Soon after World War II, numerous reports were received from depots throughout the United States describing the severe deterioration of rubber components stored on military vehicles. To solve this problem, Ordnance Corps turned to development of surface coatings and additives to improve the ozone resistance of rubber components. Contracts were let with research laboratories to develop antiozonants and with tire companies to incorporate these antiozonants into end-items which were evaluated for ozone resistance at Los Angeles and other test sites.

The results of static exposure tests have shown that SBR rubbers which crack during the first month of exposure in Pasadena, Calif., can be protected against ozone cracking one to two years or more with three parts of N,N′-di-2-octyl-p-phenylenediamine and one part wax. Likewise, nitrile rubbers were given the same protection with four parts of nickel dibutyldithiocarbamate (N.B.C.) and one part wax. Results also indicated the loss of ozone resistance when butyl and chloroprene rubbers, with inherent ozone resistance, are highly plasticized. Further, it was shown that such a loss can be regained by addition of suitable antiozonants and wax.

The importance of exposure tests at Pasadena and elsewhere are reflected in the issuance of government specifications with rigid antiozonant requirements in the rubber end-items.

10:30 a.m.-13. Chemical Inhibition of Ozone Degradation of SBR. H. W. Kilbourne, G. R. Wilder, J. E. Van Verth, J. O. Harris, Monsanto Chemical Co., organic chemicals division, Nitro, W. Va.

A description of appropriate laboratory testing methods and a comparison of commercial antiozonants are given in this paper. The highest levels of antiozone activity are realized with disubstituted aromatic amines. The *para*-phenylenediamines, substituted di- and tetrahydroquinolines are the most active members studied. Variations in chemical structure of these compounds involving substitution of electro-positive and electro-negative groups effect significant changes in antiozonant activity. Steric influences are illustrated by comparing polysubstituted derivatives. A mechanism of chemical inhibition of ozone degradation of SBR is postulated.

11:00 a.m.-Business Meeting.

11:15 a.m.-14. Ozone Cracking of Rubber in the Los Angeles Area. A. J. Haagen-Smit, California Institute of Technology, Pasadena; M. F. Brunelle, L. A. County Air Pollution Control District, Los Angeles; **J. W. Haagen-Smit,** A. O. Beckman, Inc., South Pasadena.

Cracking of rubber, due to the presence of ozone, was measured in the Los

Disneyland Town Square

Angeles area by measuring the number of cracks and the crack depth after exposure of standardized bent rubber strips to the atmosphere. The cracking shows a daily and seasonal variation due to the difference in ozone concentration as well as difference in temperature.

The ozone concentration usually reaches a maximum during the day and is highest during the summer months. Its origin has been traced to the action of sunlight on mixtures of organic material and oxides of nitrogen, common air pollutants in urban areas. A comparison with chemical measurements of the oxidizing power of the air shows a similar trend.

The rubber test used is believed to agree more closely with the practical effects on rubber goods, since it integrates the variable action of ozone due to large fluctuations in its concentration and the reaction rate due to climatological factors.

Results over a three-year test period are presented, as well as a comparison with the oxidant values measured in the same area.

11:45 a.m.-15. Factors Influencing the Ozone Resistance of Neoprene Vulcanizates under Flexure.[5] R. M. Murray, Du Pont.

The importance of using dynamic testing conditions has become increasingly apparent in evaluating the ozone resistance of elastomeric vulcanizates. Results obtained under mild conditions of flexure may be the reverse of those obtained when specimens are held under constant stress or strain.

An ozone chamber is described which has capacity for specimens of 24 cured compounds to be tested simultaneously under static and two different flexing conditions.

A comparison is given of the ozone resistance of vulcanizates prepared from a number of different elastomers and elastomer blends containing the same volume loading of SRF carbon black. Emphasis is placed on the effects of compounding ingredients (amount and type of loading, plasticizer, wax and especially antiozonant) on the ozone resistance of the neoprene vulcanizates. Increasing amounts of antiozonant are shown to provide increasing ozone protection, but bloom and scorch become serious limiting factors.

Friday Morning—May 15
Rubbers, Etc.
General Papers
B. R. Snyder, Presiding

9:00 a.m.-16A. The Chelating Agent in SBR Sulfoxylate Polymerization. R. D. Spitz, **A. K. Prince,** Dow Chemical.

The effect of various aminopolycarboxylic acid chelating agents on a typical sulfoxylate styrene-butadiene rubber polymerization recipe has been studied. The overall recipe used was:

Biltmore Headquarters Hotel

	Parts
Butadiene	70
Styrene	30
Deionized water	180
Diisopropyl benzene hydroperoxide	0.10
Sodium formaldehyde sulfoxylate dihydrate	0.07
Potassium palmitate	4.50
Tertiary dodecyl mercaptan	0.30
Potassium chloride	0.30
Ferrous sulfate (heptahydrate)	0.02
Chelating agent in various molar ratios to iron	
Temperature	5° C.
pH	10.5-10.6

Studies of only the polymerization rate were made, the system designed to produce a 60% conversion level in six hours. No extensive measurement of the properties of the coagulated rubber was attempted.

Data obtained under closely controlled conditions of concentration, temperature, and pH will show:

1. Of the group of chelating agents based upon the following: ethylenediamine tetraacetic acid; diethylenetriamine pentaacetic acid; hydroxyethylethylenediamine triacetic acid; Di (hydroxyethyl)glycine; nitrilotriacetic acid; hydroxyethyliminodiacetic acid, only those based upon EDTA support the polymerization reaction.

2. Differences in purity between reagent grade and commercial forms of EDTA appear to have no effect on the polymerization rate.

3. The efficiency of the widely used commercial mixture of tetrasodium EDTA and sodium dihydroxyethylglycinate is apparently only due to the former material in the mixture.

4. Varying the molar ratio of chelating agent to iron through the range 0.4 to 2.0 has little effect on the polymerization rate.

These data suggest an area of significant savings in raw material and handling costs to producers of sulfoxylate rubber.

9:20 a.m.-17A. Preparation and Physical Properties of Mixtures of Butadiene-Acrylic Acid and Butadiene-Vinylpyridine Elastomers. C. A. Uraneck, R. J. Sonnenfeld, Phillips Petroleum Co., Bartlesville, Okla.

Butadiene-acrylic acid and butadiene-2-methyl-5-vinylpyridine copolymers were prepared, and mixtures of these copolymers were evaluated in standard sulfur formulations and as green films. Recipes were developed for the copolymerization at 5° C. of butadiene and acrylic acid at monomer ratios varying from 95/5 to 60/40. No problem was encountered in the preparation of butadiene-2-methyl-5-vinylpyridine copolymers. Means of preparing stable mixtures of solutions and of latices of the copolymers were developed.

Evidence of intermolecular action of the carboxylic and pyridyl groups can be obtained for mixtures of the copolymers in carcass and tread formulations if the zinc oxide and stearic acid contents are maintained relatively low, 1.0 phr. each. All properties, stress-strain, dynamic, and static, were affected when the monomer ratios of the copolymers were lower than 90/10. The bond formed was probably a weak hydrogen bond association because some of the properties, especially tensile, were markedly affected by temperature.

Green films prepared by mixing solutions or latices of the copolymers demonstrated high tensile, 1800-3000 psi., if the monomer ratio was 50/50 butadiene-functional monomer, and the mixing was performed under the proper conditions.

These results indicate that mixtures of elastomers containing functional groups capable of interaction are another variable which can be utilized in compounding these rubbers.

9:40 a.m.-18A. Constitution and Variability of Rubber from Individual Trees. A. R. Kemp, Rubber Technology Foundation, University of Southern California, Los Angeles.

Special procedures are described for collecting, stabilizing, and studying variations in rubber taken from individual trees.

[5]Contribution No. 153 of the elastomers laboratory.

The color, hardness, solubility, intrinsic viscosity, and gel content are shown to vary widely in rubber from 24 individual trees in a Costa Rica estate. These data are compared with those for crepe and smoked sheet. Some unpublished data obtained several years ago on different types of rubber grown in an experimental garden at Miami, Fla., are presented for comparison.

Fractionation, solubility, and viscosity studies yield data throwing new light on the composite nature of the sol and gel components in rubber. The possible causes of the wide variations in rubber from individual trees are discussed.

Data are presented on the relative viscosity stability of pure rubber hydrocarbon in benzene solution when kept in the darkness and exposed to light. Light is shown to be the principal cause for the instability of rubber solutions which are very stable in darkness.

Fractionation studies on freshly tapped latex and crepe rubber have been carried out for comparison.

The results of the present investigation are compared with studies made by Bloomfield in Malaya on rubber latex as directly tapped.

10:00 a.m.-19A. Butyl Rubber Latex —A Review of Its General Properties in Non-Transport Applications. Alfred L. Miller, **Kenneth W. Powers,** Esso Research & Engineering Co., Linden.

Previous publications with regard to butyl rubber latex have been concerned with tire cord adhesion. With the approaching commercialization of this new elastomer latex, evaluation and study have been expanded to many non-transport fields in which the unique combination of properties available in dry butyl rubber, such as low permeability to gases; good resistance to ozone, oxygen, and chemicals; good gum tensile properties; and high elongation, could be advantageously applied in latex form. Some typical fields of application in which butyl latex shows probable utility include: adhesives, paper coating and proofing treatments, binder systems in textiles, and vulcanized films.

Data will be presented showing the unusually good mechanical and freeze-thaw stability of butyl rubber latex. A high tolerance for polyvalent ions, acids, and bases and usefulness over a very broad pH range will also be described. Viscosity can be varied and controlled through the addition of commercial thickeners. Cure systems have been developed which show good activity at boiling water temperatures. More economical cure systems have been developed for use in the 240 to 260° F. range. Tensile, tear, and permanent set data will be presented on these cured films. In addition, pigment reinforcement effects in uncured, unsupported films will be discussed.

Studies of the interactions of butyl rubber latex with representative pigments and adhesives separately and together reveal satisfactory compatibility over broad concentration ranges. Pigment-coated paper evaluations show butyl rubber latex to be of considerable interest with regard to a number of properties such as print quality, ink holdout, etc.

10:20 a.m.-20A. Gel Formation in Styrene-Butadiene Rubbers. C. A. Carlton, J. M. Huber Corp., Borger, Tex.

Cut growth of styrene-butadiene tire tread compounds has been a serious problem since the inception of the synthetic rubber industry. This study was undertaken to (1) determine the effect of processing conditions and various rubber compounding ingredients on the formation of gel in styrene-butadiene copolymers and (2) to determine the effect of gel on the physical properties of unvulcanized and vulcanized SBR compounds with particular reference to tire tread cut growth and cracking.

Gel formation during processing is a function of time and temperature. The amount formed is influenced by the type of processing since oxygen plays an important role in gel formation.

A comparison of the various commercial grades of styrene-butadiene rubbers reveals that nearly all form some gel during hot mastication. In general, the oil-extended rubbers form less gel than the non-extended ones. Some few form no gel.

A study of the effect of accelerators, antioxidants, antiozonants, chemical plasticizers, retarders, and activators reveals that some completely inhibit gel formation, others are without effect, and some are promoters of gel formation. The derivatives of para-phenylene diamine are particularly effective gel inhibitors.

The presence of gel in SBR tire tread compounds has a radical effect on physical properties. Modulus increases materially; tensile strength decreases substantially, and cut growth resistance decreases radically with an increase in gel content.

Careful attention to processing conditions and to the selection of compounding ingredients can result in improved SBR compounds.

10:40 a.m.-21A. Terpolymer Rubbers: Standardization of Infrared Analysis by Chemical and Radiotracer Methods. G. B. Sterling, J. G. Cobler, D. S. Erley, F. A. Blanchard, Dow Chemical.

Considerable interest has developed recently in tailoring polymeric materials for specific end-uses. Such tailoring is accomplished by copolymerizing two or more monomers in definite proportions. The physical properties exhibited by the synthetic polymers depend to a large extent on exact polymer composition which generally differs from the monomer charge ratio. Consequently considerable effort has been devoted to methods for the analysis of such products. Infrared spectroscopy has proved particularly useful in this work as it is rapid, specific, and accurate; but samples of known composition are required as standards for quantitative work. The present paper describes a novel approach to the development of an infrared method for determining the composition of one of these tailored products, a terpolymer rubber of methyl isopropenyl ketone (MIK), butadiene, and acrylonitrile (VCN). The method could be readily used on many products of this type.

The infrared spectrum obtained from a film cast from the latex shows the expected absorptions of VCN, MIK, and butadiene. Since each of these absorption bands is free of interference from the other components, the terpolymer rubber composition might be determined from the infrared spectrum if standards of known composition could be obtained.

Chemical analysis alone was found to give erratic results; therefore, special standard latex samples were prepared using MIK-C14. These were analyzed chemically for VCN, and by radiotracer analysis for MIK to give the data necessary for standardizing the infrared method.

This paper describes the preparation of MIK-C14, the terpolymer rubber standards, the procedures used to analyze the standards, and the development of the final infrared spectroscopic method.

11:00 a.m.-22A. A High-Temperature, Fluid-Resistant Fluorocarbon Elastomer. D. A. Stivers, F. J. Honn, Minnesota Mining & Mfg. Co., St. Paul, Minn.

Elastomeric polymers which are resistant to solvents and functional fluids at high temperatures, especially above 400° F., meet many current needs in the aircraft, missile, automotive, and chemical industries. They are expected to play an even more vital role in designs of the future.

The new elastomer described in this paper is a high-strength fluorocarbon possessing a combination of resistance to heat and compression set in the presence of destructive fluids that makes it widely applicable in the temperature range of 400 to 600° F. These qualities are supplemented with tear strength, abrasion and ozone resistance, electrical and low-temperature properties that give performance which in many ways is highly competitive with the lower priced non-fluorinated special-purpose elastomers. The viscosity of gum and compounded stocks readily adapts it to modern rubber fabricating methods.

General properties are described, and compounding techniques for obtaining optimum resistance in solvents, oils, acids, and functional fluids under conditions of high heat and compression are presented.

11:20 a.m.-23A. Fibrous Silicone Rubber. R. A. Russell, Connecticut Hard Rubber Co., New Haven, Conn.

A new physical form of silicone rubber has been developed. This new form is a fibrous silicone rubber mat which offers improvements over usual sponged or foamed mats. Unlike open or closed-cell expanded rubbers, the new material achieves its properties by a weblike arrangement of small hollow filaments bonded at their intersections.

A spray process by which fibrous silicone rubber mats can be produced in continuous lengths from a variety of commercially available silicone compounds is described and illustrated.

Physical properties of fibrous silicone rubbers are compared with those of conventional cellular rubbers to demonstrate how the properties are affected by the structure. Data illustrating the manner in which the fibrous structure results in the improvement of such properties as compression set, air permeability, strength, and vibration absorption are presented.

Potential applications of fibrous silicone rubber are discussed briefly.

11:40 a.m.-24A. A Study of Abrasion and Road Wear of Butyl Tires through Designed Compounding Experiments. R. L. Zapp, **C. W. Umland, II,** Enjay Laboratories, Linden; L. R. Sperberg, 3-T Fleet, Inc., Odessa, Tex.

The study of the effect of compounding variables on the road wear of experimental butyl tires was facilitated by statistically designed laboratory compounding experiments. Because rubber compounds possess many variables, orthodox experiments which attempt to study one variable at a time result in an unwieldy number of experiments. When attempts are made to coordinate expensive road wear tests with orthodox experiments, financial burdens may become excessive. However, if a certain variable asserts itself with statistical significance, in a simple designed experiment, limited road wear tests based upon these directions can be coordinated with laboratory experiments.

In these studies devoted to abrasion resistance and road wear, four ingredients of a tread compound were varied according to a Gracco Latin Square design. The effect of these ingredient variations upon laboratory abrasion resistance was observed using a Lambourn abrader. From these experiments, using one molecular weight level of butyl (Enjay Butyl 218), it was concluded that:

1. The most significant improvement in abrasion resistance could be obtained by reducing the sulfur content of the formulation. Reduction in sulfur level from 1.5 parts to 0.5-part per 100 parts of polymer resulted in a 40% reduction in *abrasion losses.*

2. To a less significant degree reduction in carbon black content from 60 to 40 parts of SAF black per 100 parts of polymer resulted in lower *abrasion losses.* Further reduction to 30 parts of SAF black produced no further reduction in abrasion losses.

3. Variations in oil plasticizer content, and Elastopar, heat promoter, produced much less significant effects.

Butyl tires of the same tread design and construction were then produced and tested for road wear at a 70-mile-per-hour sustained driving speed. Compounds following the dictates of the designed experiment indicated a *road life improvement* of 30% as the sulfur content was lowered from 1.5 to 0.75- to 0.5-part per 100 of polymer. In general, these compound changes that produced the improved road life formed softer and more extensible vulcanizates.

Friday Morning—May 15
Vulcanization, Etc.
General Papers
A. W. Hawkins, Presiding

9:00 a.m.-16B. Room-Temperature Sulfur and Non-Sulfur Vulcanization of Natural Rubber. I. With Sulfur and Piperidinium N-Pentamethylenedithiocarbamate. II. With Quinone Dioxime (GMF) and Yellow Mercuric Oxide. Harry L. Fisher, University of Southern California.

Calendered slabs of pale crepe rubber containing an ultra-accelerator, piperidinium N-pentamethylenedithiocarbamate, and zinc oxide were embedded in powdered sulfur and kept at room temperature. Tensile strengths up to 294.2 kgs./sq.cm. (4185 psi.) were obtained; elongations were up to 530%; and the combined sulfur in 115 weeks was 3.60%.

Calendered pale crepe rubber containing 10 parts of yellow mercuric oxide to 100 parts of rubber allowed to stand covered with quinone dioxime (GMF) powder at room temperature slowly vulcanizes, reaching a tensile strength of 53.1 kgs./sq.cm. (754 psi.) in 405 days, and retaining this condition for at least twice this same period of time. The elongation reached 740%, and the set was 0.16.

The tensile strength obtained is almost as high as that obtained in a press cure with quinone dioxime alone.

The untreated sample containing yellow mercuric oxide alone showed a setup with only 5.3 kgs./sq. cm. (75 psi.) tensile strength.

Calendered pale crepe with no mercuric oxide set in quinone dioxime and calendered pale crepe containing two parts of quinone dioxime, each set standing at room temperature, showed no signs of vulcanization.

9:20 a.m.-17B. Vulcanization with Tetramethyl Thiuram Disulfide. E. M. Bevilacqua, U. S. Rubber Research Center, Wayne, N. J.

Certain simple stoichiometric requirements for obtaining the maximum yield of cross-linking during vulcanization with tetramethyl thiuram disulfide (TMTD) which have not been explicitly described previously are given. This information together with new analytical data on products formed during the reaction makes it possible to evaluate critically efforts which have been made to explain the high efficiency of TMTD "sulfurless" vulcanization. It is now possible to outline the mechanism within rather narrow limits although some details require further experimental study.

9:40 a.m.-18B. Sulfur Donor Vulcanization Systems Yield Improved Butyl Rubber Vulcanizates. C. J. Jankowski, K. W. Powers, R. L. Zapp, Enjay Laboratories.

Improved compression set, Goodrich flexometer, and aging properties are obtained when a butyl rubber compound is vulcanized with sulfur donor systems such as morpholine disulfide or dibutyl xanthogen disulfide in conjunction with accelerators. Comparison of stress relaxation at elevated temperature and high-temperature swelling indicate a different cross-link is obtained with a sulfur donor system than is obtained with an elemental sulfur system.

Data indicate that the bond obtained from elemental sulfur opens at elevated temperature, allowing the vulcanizate to deform under load and then closes when the temperature is decreased so that the deformed shape is maintained. The bond obtained with a sulfur donor system does not show this bond opening so that smaller permanent deformations under load are obtained. The improved flexing performance and aging resistance of the sulfur donor vulcanizate are further manifestations of the stability of this type of cross-link and its resistance to chemical attack. Proposed structures for the bond obtained with sulfur donor systems are: (1) dialkyl disulfide cross-link rather than dialkenyl disulfide cross-link; (2) dialkenyl monosulfide cross-link rather than dialkenyl disulfide cross-link.

10:00 a.m.-19B. Cardolite® Brand NX-3256 and NX-3216 Resins for Curing Butyl Rubber for Heat Resistant Applications. F. A. Moller and **D. A. Stivers,** Minnesota Mining.

For several years now, derivatives of para-substituted phenols have been known to cure butyl rubber in such a way as to raise the upper limit of heat resistance another 100° F. No mention was ever made of meta-substituted phenols performing this same task. It was discovered, however, that a dimethylol derivative of the meta-substituted phenol which forms the major component of cashew nut shell liquid, vulcanized butyl rubber producing many of the same properties obtained with their para-substituted forerunners.

This paper presents data on a solid meta-substituted resin, Cardolite NX-3216 Resin, that produces a high state of cure when used in conjunction with

stannous chloride dihydrate as a catalyst. Heat aged properties are comparable to those obtained with para-substituted phenols, but processing is more difficult owing to a higher scorch rate. A technique to prevent scorch, using a partially hydrolyzed form of stannous chloride dihydrate in conjunction with a small amount of a hydrogen halide donor, such as, sec. butyl chloride, is illustrated. The properties of a non-scorching liquid meta-substituted resin, Cardolite NX-3256 Resin, also produce good original and heat aged vulcanizate properties when cured with a stannous chloride dihydrate catalyst.

10:20 a.m.—20B. Chemical-Loaded Molecular Sieves as Latent Curing Aids. III. A New Resin Curing System for Butyl Rubber. F. M. O'Connor, R. L. Mays, Linde Co., Division of Union Carbide Corp., Tonawanda, N. Y.

The use of a heat-reactive dimethylol phenolic resin for the cross-linking of butyl rubber has been commonly referred to as the "resin cure" of butyl rubber. In order to obtain practical cure rates in this type of curing system, catalysts or accelerators have been used in conjunction with the phenolic resin. Materials such as heavy metal halides, chlorinated paraffin wax, halogenated elastomers, or organic sulfonic acids have been the most common accelerators used. Some of these materials are so active that formulations containing them are difficult to process owing to premature curing of the rubber, or staining or sticking to processing equipment. Others are so inactive that recipes containing them must be cured at relatively high temperatures or for very long curing cycles at conventional temperatures.

The use of hydrogen chloride-loaded Molecular Sieve[6] in conjunction with zinc oxide and polychloroprene in this type system offers very fast cure rates without the concomitant disadvantages normally encountered when active catalysts are used. It is possible by adjusting the ratio of hydrogen chloride-loaded Molecular Sieve, zinc oxide, and polychloroprene to obtain the processing, curing, and aging characteristics necessary to meet a wide variety of specifications.

This paper presents data which show the utility of this acceleration system in formulations used in the fabrication of tire curing bags. The versatility of this system should also offer advantages in formulations designed for many other applications.

10:40 a.m.-21B. The Influence of the Order of Addition of Compounding Ingredients on Stocks Milled at Elevated Temperatures. H. C. Jones, New Jersey Zinc Co. (of Pa.), Palmerton, Pa.

[6]RUBBER WORLD, June 1958, p. 424.

Emphasis on greater production rates through the utilization of high speed, high ram pressure mixing operations has resulted in discharge temperatures in excess of 300° F. for many rubber compounds. The curatives such as zinc oxide, accelerator, and sulfur are reactive at the elevated temperature, and the order of addition of these ingredients to the rubber batch can have a marked effect on the processability of the uncured compound and the quality of the finished article.

The laboratory-scale experiments described in this paper indicate that early addition of zinc oxide improves the quality of the rubber compound and contributes to accelerator stability at the elevated mixing temperatures. Greater processing latitude is gained, however, by late addition of zinc oxide to the rubber batch.

The influence of milling order on the high-temperature mixing of organic accelerators, notably thiurams and some sulfenamides, has a pronounced effect on the properties of the resultant compounds. Carbon black was a distinctive factor in these studies, with furnace black behaving differently than channel. The investigation was based primarily on natural rubber together with several cold SBR stocks.

Stress-strain, tear, pendulum rebound, and Mooney scorch at 250° F. were the properties determined.

11:00 a.m.-22B. Mold Lag in Laboratory Rubber Sheet (Modulus) and Rebound Block Curing. H. A. Freeman and S. D. Gehman, Goodyear.

Since modern accelerators give relatively fast cure to rubber compounds, it becomes increasingly important to evaluate properly the cure of laboratory test specimens where state of cure is concerned.

Modulus test sheets were cured at 260, 280, 300, and 320° F., according to standard ASTM practice. Precision timing and thermocouple determinations showed that mold heat lag at start of cure (because mold was out of press to load) was compensated for by "cooling" cure after press starts to open. Therefore no mold lag factor should be used in evaluating the total press sheet cure. For example, a specified sheet cure of 20 minutes at 260° F. gives the test piece an actual cure of 20 minutes at 260° F.

More mold lag occurs with heavier molds and thicker specimens than in the case of sheet cures. Rebound blocks one- by one-inch by two inches were thermocoupled at the center and at the outer surfaces. Considering both "in mold" and "cooling" or total cure, there is a net heat lag at the center of the block in a high black tread compound of eight minutes' equivalent cure at the given temperature. For a pure gum compound the net center heat lag is 11 minutes' equivalent. The net "mold lag" at the top and bottom faces of the block is one minute, for this thicker mold, but more at the side faces. Rebound block cures in the laboratory should be governed accordingly.

This problem was also studied by mathematical heat flow calculations. However, the thermocouple shows actual heat flow under standard cure conditions and takes into account the total mold lag.

11:20 a.m.-23B. Development of Rubber-Based Insulation Materials for Solid Rocket Motors. O. D. Ratliff, H. J. McSpadden, Astrodyne, Inc., McGregor, Tex.

An insulator based on an asbestos loaded rubber has been developed and tested in rocket motors with firing durations up to four minutes.

Comparative tests of rubber based insulators *versus* commercially available insulators have been run subjecting the insulation materials to an oxygen-natural gas flame for 20 minutes. These tests have shown that during the first 60 seconds the rate of heat transfer through the rubber based insulators is about one-third that of the better commercial insulators. After one minute the difference in rate of heat transfer becomes less marked.

After exposure to a natural gas-oxygen flame for 20 minutes, the best rubber based insulator indicated a temperature of 785° F. on the back side of a 0.3-inch thick sample. A commercial phenolic-glass laminate insulator, after the same test, indicated a temperature of 1550° F.

Rocket motor evaluation of a rubber based insulator was carried out in a 10-inch diameter case utilizing an end burning charge of a high energy metallized propellant. The maximum temperature recorded on the case wall was 300° F. after a firing duration of 244 seconds.

11:40 a.m.-24B. The Structure of Carbon Blacks. Andries Voet and William N. Whitten, Jr., J. M. Huber Corp.

The structural involvement of a carbon black, whether dispersed in gases, liquids, or elastomers, is the result of an interplay of attractive and repulsive forces between individual particles. The present investigation employs a recently developed electrical approach, by means of conductivity and dielectric constant measurements, for the study of the structure of an extensive series of commercial and experimental blacks dispersed in a white mineral oil at several concentrations and temperatures, while subject to varying rates of shear.

Differences in electrical conductivities have been found between quiescent and sheared dispersions varying from none up to six orders of magnitude. Equally, large differences in the rates of conductivity changes resulting from shear rate changes were observed, allowing conclusions about magnitude

and rate of structure formation in blacks.

A minimum was found in the conductivity-shear rate relation for all blacks, indicative of the forces required for mechanical structure elimination. An induction period for reformation of the structure was observed varying from less than one to several hundreds of seconds, dependent upon the type of black.

It appears that a system of classification of the structural characteristics of carbon blacks is possible on the basis of the degree and the rate of structure build-up and the inherent resistance to deflocculation. The application of potential energy curves to analyze structure phenomena contributes greatly to a more basic understanding of the extreme differences in structural behavior of different types of black.

A correlation appears to exist between the structure and the specific plastic viscosity of the carbon black dispersions as measured in a high shear rotational viscometer.

NCRG Hears Talk on Jet Travel Advances

The Northern California Rubber Group is apparently planning to be a high-flying organization. Members spent their February meeting learning some of the finer points of jet travel from Ray D. Kelly, superintendent of technical developments of United Air Lines. Mr. Kelly explained to his audience how they could leave California one morning, arrive in the East in time for dinner, spend a full day at business the following day, and return to California with time to spare for a full night's sleep.

In giving some of the economic features of jet travel to help explain how the initial cost of jet liners is offset by productivity, Mr. Kelly used a figure of passenger miles per hour. Using this figure, he claimed that a DC-8 jet would be equal to 3.5 DC-7's and among other methods of transportation would equal 236 present-day automobiles or 887 stagecoaches of an earlier era. According to the speaker, a major problem facing the jet age is the congestion at the airports. Air transportation facilities have not kept up with the needs of the times. New developments such as improved baggage handling techniques and ticket sales will soon be available to help alleviate the problem.

The meeting was held February 19 at the Berkeley Elk's Club, Berkeley, Calif., with a dinner and social hour preceding the business meeting. President D. Kutnewski, Burke Rubber Co., announced the following committee chairmen for the year: ACS director, R. J. Reynolds, Shell Development Co.; Los Angeles ACS meeting, W. H. Deis, Merck & Co., Inc., and R. T. Hickcox, Oliver Tire & Rubber Co.; Christmas party, C. Mayerhauser, New Jersey Zinc Co.; program, C. C. Corkadel, Oliver Tire; education, W. H. Eustis, Shell Oil Co.; outing, D. Robertson, Titanium Pigment Corp.; publicity, D. M. Preiss, Shell Oil; reception, K. Anderson, Dow Corning Corp.; summer outing, J. Moriarty, Thermoid Division, H. K. Porter Co.; ways and means, V. Carriere, Mansfield Tire & Rubber Co.; year book, B. Fuller, E. I. du Pont de Nemours & Co., Inc.

Rubber Division, CIC, May 1 Program Given

Announcement of the program for the annual meeting of the Rubber Chemistry Division of the Chemical Institute of Canada, to be held at the Sheraton-Brock Hotel, Niagara Falls, Ont., Canada, on May 1, has been received. This meeting is to be held during the morning and the afternoon, and the International Meeting of the Buffalo and Ontario Rubber groups will be held at the same place on the evening of the same day.

Preregistration forms for the Rubber Division, CIC, meeting are available from R. Tartaglia, B. F. Goodrich Canada, Ltd., Kitchener, Ont., Canada; and J. L. Macdonald, Du Pont of Canada, Ltd., P. O. Box 660, Montreal, P.Q, Canada.

The Rubber Division papers will be grouped into one session on aging and weathering of elastomers and one session of general papers. The titles and authors are as follows:

1. A New Chlorine-Containing Butyl Polymer. R. E. Clayton, J. V. Fusco, L. T. Eby, Enjay Co., Inc., New York, N. Y.

2. Some Results of Kinetic Studies of Sulfur Vulcanization in the Presence of Accelerators. Otto Lorenz, Goodyear Tire & Rubber Co., Akron, O.

3. Chemical Nature of Filler Reinforcement. M. C. Brooks, F. W. Boggs, R. H. Ewart, United States Rubber Co., New York.

4. Silicone Rubber Developments. Philip C. Servais, Dow Corning Corp., Midland, Mich.

5. Theory and Practice of Antiozonant Usage. Thomas H. Newby, U. S. Rubber, Naugatuck Chemical Division, Naugatuck, Conn.

6. Effects of Antiozonants on Weathering of Tires. Glenn Alliger, Firestone Tire & Rubber Co., Akron.

7. Aging of Rubber—Effects of Metal Contamination. R. L. Stafford, B. N. Leyland, Imperial Chemical Industries, Ltd., Manchester, England.

8. Development of a Low-Temperature Anti-Checking Wax. S. W. Ferris, J. S. Sweely, Sun Oil Co., Marcus Hook, Pa.

9. A Quantitative Ozone Test for Small Specimens. D. C. Edwards, E. B. Storey, Polymer Corp., Ltd., Sarnia, Ont.

Polyethylene Uses Outlined to NCRG

Two speakers on polyethylene gave the Northern California Rubber Group the latest information on the uses of this material and on some of its special properties. Both men represented the Visking Corp. Harry Hamilton, Jr., described some of the major uses for polyethylene film, and A. A. Stella presented the story on the use of polyethylene film to wrap synthetic rubber bales.

Mr. Hamilton listed food packaging as one major use. The film is tasteless, odorless, non-toxic, tear resistant, and heat sealable, making it good for general food packaging. The added properties of low-temperature resistance make the films excellent for frozen food packaging. Another major use described by the speaker was as the backing for tread rubber to replace holland cloth. An early difficulty in this use was the poor printability of the film. This has been overcome so that color codes may be used, and thus the way has been opened for increased usage in this field. Hamilton also listed as a major and newer use a polyethylene film layer under concrete where floor tile is to be laid on the upper surface. The moisture barrier formed by the film allows a better and more lasting adhesion to be formed between tile and concrete.

Mr. Stella, in describing the synthetic rubber bale wrap use, stated that most of the soapstone formerly used has been eliminated by the polyethylene wrap. Present film used is about two mils thick. Much development work is being devoted to producing a lower melting polyethylene for greater compatibility with the rubber. The lower strength which goes with the lower melting point has prevented widespread use of these new films at the present time.

A new modified film was also reported by Mr. Stella. A black film has been developed for outdoor storage of rubber or other compounding ingredients. This film is produced in sizes from three inches to six feet in width and from 0.4 to 20 mils thick.

This program, titled "Polyethylene—Production of Films and Expanded Usage," was presented to the NCRG at the meeting held March 12 at the Berkeley Elk's Club, Berkeley, Calif. A pleasant social hour and dinner preceded these talks.

Southern RG Brought Up-To-Date On Special Polymers and Plasticizers

A very complete look into the question of plasticizers for rubber and the latest information on some of the newer elastomers were provided by panelists at the Southern Rubber Group's January meeting in Dallas, Tex. This two-day winter meeting was held on January 30 and 31 at the Statler-Hilton Hotel in Dallas. The panel on plasticizers was held on Friday afternoon, and the panel on new elastomers on Saturday morning. A banquet was held Friday evening, with R. L. Fitzpatrick, American Airlines, Dallas, as the speaker. His topic was "Attitude *versus* Aptitude."

The plasticizer symposium was moderated by A. K. Remy, Mastic Tile Corp. of America, Houston, Tex., and featured the following panelists: Albert E. Myers, Shell Oil Co., New York, N. Y.; Stewart S. Kurtz, Jr., Sun Oil Co., Marcus Hook, Pa.; A. L. Robinson, Harwick Standard Chemical Co., Chicago, Ill., who delivered a paper prepared by F. S. Rostler, Golden Bear Oil Co., Oildale, Calif.; and Joe Stonis, C. P. Hall Co., Chicago.

Moderator for the "Special-Purpose Polymer" panel was A. C. Porter, Convair Division of General Dynamics, Fort Worth, Tex.; and the panelists were: O. C. Keplinger, General Tire & Rubber Co., Akron, O.; Edgar Tufts, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; H. E. Railsback, Phillips Petroleum Co., Bartlesville, Okla.; R. M. Savage, General Electric Co., Waterford, N. Y.; and George Konkle, Dow Chemical Corp., Midland, Mich.

Plasticizers Described

The first speaker on plasticizers was Mr. Myers. His paper provided a look at plasticizers and extender oils as to what they are and what they do. Using an illustration of poppet beads to represent the molecules of rubber Mr. Myers presented a look, greatly magnified, at the way oils internally lubricate rubber. The difference between chemical softeners which act by chain scission and physical softeners which act as intermolecular lubricants and reduce polar attraction of the rubber molecules was described.

The principal classifications of oils in order of importance to the rubber compounder were listed as: (1) petroleum fractions (naphthenic oils, aromatic oils, resins, waxes, asphalts, mineral rubber); (2) pine products (pine tar, pitch, resins); (3) coal-tar products (coal-tar oils, pitch, resins); (4) natural fats and oils and their derivatives (fatty acids, vegetable oils, blown oils, factices); (5) synthetic organic compounds (ester plasticizers, liquid polymers).

Presentation of information on the individual classes was done in reverse order. The ester plasticizers were omitted since another panelist was to cover them. Natural fats and oils were described as being low in polarity, thus being low in compatibility, but having some lubricating properties. Stearic acid was indicated as being the most important single product in the group. The acid group makes the stearic acid an active pigment-wetting agent and, being strong enough to react with zinc oxide or basic accelerators, tends to combine with them and thus becomes part of the vulcanizing system.

The coal-tar products are mostly highly aromatic hydrocarbon materials. They are compatible with most rubbers and aid calendering and extrusion. These coal-tar products are limited by high brittle point, however, and also have to be evaluated for cure effect since they may retard or accelerate the cure.

Pine products have had a long history in the rubber industry. Along with the use of pine products as softeners goes some chemical reactivity which produces some special effects in rubber. Pine products have a retarding effect due to their acid nature and thus help in reducing scorch. Pine products are very good in tackifying and pigment-wetting in natural rubber, but produce poor aging compounds unless special modified rosins are used.

Petroleum plasticizers are most useful when the molecular size is about 20 carbon atoms per molecule or more. There is a very wide range of products between paraffin wax which is low in polarity and thus has a low affinity for rubber and highly aromatic oils of high polarity and affinity for rubber.

The two most important variables, as reported in the paper, are polarity and molecular weight, or viscosity. The polarity determines the compatibility and thus the amounts that can be used and the ease of incorporation. The viscosity or molecular weight must be chosen to give proper properties in low-temperature flex, hysteresis, and resilience to the rubber vulcanizate.

Questions and Answers

Q. In recent months there have been numerous recommendations for the use of naphthenic oils in a wide range of butyl rubber compounds. Why this change in thinking? What is the effect of variation of iodine number and what iodine number range is most satisfactory?

A. Myers. In order to give butyl rubber enough unsaturation to be cross-linked or vulcanized with sulfur, a small amount of diolefin isoprene is copolymerized with the isobutylene. These olefins in butyl rubber are spaced relatively far apart on the molecular chain in comparison with SBR, and if the plasticizer used is appreciably reactive to sulfur, it will compete with these few olefins in the butyl rubber, and the cure will be inadequate or at least retarded. Since iodine number is a fair measure of the sulfur reactivity of the oil, only oils with a low iodine number should be considered for use with butyl rubber. An iodine number of 25 is considered the maximum acceptable value, and, of course, there is no minimum.

Both naphthenes and paraffins are acceptable with regard to iodine number so that the problem becomes one of freezing point requirements. Since the temperature at which a 100-second viscosity paraffin oil becomes too stiff to pour may be plus 40° F. *versus* minus 40° F. for a naphthenic oil, the naphthenic would be preferred for low-temperature flexibility.

Q. I've been told that SBR 1712 has poorer building tack than the same type base polymer mill-mixed with the same quantity and quality of oil. Why should this be?

A. Myers. Assuming all else to be the same, the opposite effect would be

The Southern Rubber Group panel on plasticizers *(left to right)*: S. S. Kurtz, A. L. Robinson, A. E. Myers, and J. E. Stonis

expected since the mill-mix should be a poorer mix than the co-coagulated polymer. Further details of such a test would interest the author.

Q. How helpful would you expect an ultra-violet absorber to be in making non-staining rubber? Also, could you comment on the effect of trace metals *versus* highly aromatic oils as the cause of degradation in highly aromatic oil-extended SBR.

A. Myers. Although no tests have been conducted in rubber, we have had no success with ultra-violet absorbers to prevent darkening of PVC containing light-susceptible plasticizers; so I wouldn't expect them to be effective in SBR.

As to trace metals and aromatic oils promoting the softening of rubber, current tests indicate that aromatic oils in the absence of iron, copper, or manganese do not cause such softening. Residual iron can cause severe degradation under accelerated aging conditions without extending oils. Highly aromatic extending oils do increase the oxidative-degrading tendencies of iron. This enhancement of the degrading effect of iron by aromatic oils is explained by (1) a solubilizing of the iron through the formation of soluble iron complexes with the heterocyclic components of the oil and (2) active hydrogens on some of the aromatic components of the oil serving as oxygen carriers through the formation of peroxides with oxygen from the air. This degrading combination can be broken up by adding magnesium soap to block out the iron from the solubilizing reaction.

In his paper, **"Effect of Variation in Aromaticity in SBR and Special-Purpose Polymers,"** Mr. Kurtz amplified work which has been under investigation for several years and was first reported by him before the Akron Rubber Group in October, 1956. This work has led to the determination by Sun Oil Co. of a method for getting composition from physical properties of oils with very high aromatic content. The investigation has also been responsible for the brochure put out by the company on a graphic method for selecting oils for rubber compounding.

Mr. Kurtz ventured the opinion that very highly aromatic oils would decline in consideration as rubber process and extender oils. He listed as reasons for this opinion the fact that new ideas on mixing control have reduced Banbury mixing times and by varying the rotor speeds the slower black incorporation times of the less aromatic oils can be offset. Thus processibility, which has been aromatic oils' desirable feature, is discounted somewhat. To offset this advantage further, are certain disadvantages of the use of aromatic oils in rubber. Highly aromatic oils are poorer in color and so not useful for light-colored stocks. Investigations also seem to indicate that highly aromatic oils tend to cause deterioration in SBR rubber during storage. Low-temperature properties are also less satisfactory with the higher aromaticity of the oils.

On the special polymers, recent work has shown that for most uses in butyl rubber, with special reference to both low-temperature properties and heat aging, low aromatic oils are best. Neoprene, particularly WHV type, nitrile rubber, and polyvinyl chloride do require highly aromatic oils for plasticizing.

The history of classifying oils and some of the approaches toward new tests and methods for obtaining better descriptions and correlations between description and use in rubber were given by F. S. Rostler in his paper, **"The Determination of Hydrocarbon Types of Petroleum Plasticizers and Their Effect in Rubber Compounds."** In this paper, presented by Mr. Robinson for Mr. Rostler, the idea was proposed that since an oil may serve as an extender in one polymer and as a mold release agent in another, and since there are many other terms which might describe the same oil in different service, the petroleum suppliers must furnish the chemical nature of the oils so that the rubber compounder can select on this basis the product he wants. The objectives of the problem were stated to be (1) determination of hydrocarbon type, (2) determination of the factors governing the behavior of petroleum products in rubber, and (3) finding means to correlate the two.

Since any given oil fraction may have many different isomers, using structural formulas leaves much to be desired for classifying, according to the author. Physical constants and point of origin also are of dubious value in classifying oils for rubber use. The preferred method proposed by Rostler is to classify according to reactivity. Such classification cannot be based upon the groups and structures of pure organic compounds, however, since the structure may not be known. New definitions based on other groupings not listed in organic chemistry text books must therefore be used.

By use of a method based on treatment with 85% sulfuric acid, the author lists a classification system as the components are separated in this method: (1) asphaltenes, (2) nitrogen bases, (3) first acidaffins, (4) second acidaffins, and remaining (5) paraffins. Further subdivision of these five groups analytically failed to show any significant differences in compounding behavior within the groups.

This method is claimed to be much faster and less costly than many previously used or proposed.

Questions and Answers

Q. In which particular compounds are plasticizers high in nitrogen bases advantageous?

A. Robinson. Nitrogen bases are mild accelerators and peptizers. This means that in compounds where flat level cure and fast breakdown during mixing is desirable, an extender high in nitrogen bases is advantageous. High-grade hard rubber compounds requiring fast cure and even hardness in large articles, and compounds for self-sealing fuel cells which require peptizers are examples of compounds for which extenders high in nitrogen bases should be used.

Q. How does the Kurtz analysis differ from the Rostler analysis, and what are the advantages of the two?

A. Robinson. The method proposed by Kurtz is not an analysis, but a classification of oils on the basis of certain physical properties using a graphic method to locate the approximate position of an oil in the Sun Oil Co.'s group classification. This classification is based on the original Waterman analysis defining oils as to their theoretical content of aromatic rings, naphthenic rings, and paraffinic side chains.

The Rostler analysis determines the amounts of well-defined components of oils, which components are not theoretical fragments, but have actually been isolated and tested as to performance in rubber. Kurtz's contention that it is not necessary to know the make up of an oil in terms of the Rostler analysis holds true only for such applications where the quantitative distribution of components of different chemical properties such as high or low unsaturation is of no consequence. I don't know of any application in compounding where this information is unimportant. To say, for instance, that it is unimportant to know the amounts of first and second acidaffins is the same as saying that there is no difference in compounding behavior between oils having iodine numbers of 100 and oils having iodine numbers of 5.

Q. What is the recommendation for an oil to reduce cut-growth in tires?

A. Robinson. The type of oil is only one of the factors to be considered. Type of polymer, type of pigments, and the general design of the compound including acceleration are also important. You must have a compromise compound with a balance between tread wear, resilience, heat build-up, and cut-growth. In general, the oil to be used should be a relatively high viscosity oil of good compatibility with the particular polymer. Using OSR nomenclature, a "highly aromatic oil" should be used in SBR. This type oil was used for this reason in SBR 1706, 1711, and 1712.

Q. Which oils are recommended for non-staining and non-discoloring compounds?

A. Robinson. We recommend an oil free of asphaltenes and nitrogen bases, low in first acidaffins, as the best oil

for non-discoloring and non-staining compounds. The oil should be free of impurities such as reactive sulfur compounds, phenols, and metallic salts. The ultra-violet stability is also important. The purity and the composition must be most strictly controlled with PVC, slightly less for Hypalon, and less strict in order for neoprene, nitrile, butyl rubber, natural rubber, and SBR. While 20 or even 25% first acidaffins might be tolerable in SBR, a maximum of 15% is recommended for neoprene, for example.

The ester-type plasticizers were covered as to places to be used, types of uses, and specific plasticizers for use in specific places or polymers by J. E. Stonis in his talk titled, **"Ester and Special-Type Plasticizers in Compounds Subject to Normal, High, and Low Temperatures."** Roughly divided into four parts, the paper first discussed these plasticizers as to general usefulness for specific properties such as ozone, heat, low temperature, water absorption, etc., in rubber compounds. The esters were discussed as to good types to use for these requirements and as to some that are not so good for the particular use.

The second section of the paper took up the use of ester-type plasticizers in several typical end-articles such as tires, tubes, camelback, and many types of mechanical goods. In each case the use of esters in the product was discussed, and a conclusion drawn as to the general usefulness or lack of usefulness of ester types in the product.

The third section was similar to the second except that the basis here was the usefulness in specific polymers. Here again, however, the report considered the pros and cons and concluded as to the general extent of use of esters in the polymer in question.

This section was then amplified into a fourth section which took nitrile rubber as the example and presented some typical swell and oven aging data using several test oils and test plasticizers.

Special-Purpose Polymers

A report on **"Advances in Polyurethanes"** led the discussion on special-purpose polymers on Saturday morning. Using Genthane as his illustration Mr. Keplinger traced the history of urethanes and gave some of the processing methods used and many of the properties both good and bad for the use of these polymers. A report on Genthane was made by Mr. Keplinger at the Akron RG meeting in January, also, which was carried in our report of that meeting.[1]

The group was brought up to date on the **"Characteristics and Applications of Viton Fluoroelastomer"** by Mr. Tufts. Starting with the basic formula and listing of the raw polymer physical properties, the paper provided a general look at the uses, the methods used for compounding, and some of the special materials used with Viton for best results.

The properties of Viton vulcanizates were listed along with some descriptions of many of their major advantageous characteristics. Normal cure temperatures and some typical and potential uses were enumerated in the initial general coverage section of the paper.

The later sections of the paper dealt with specific compounding of Viton. A compound usually contains a stabilizer, a filler, and a curing agent added to the Viton polymer. Stabilizers used so far are magnesium oxide, a combination of zinc oxide and lead phosphite (Dyphos), and litharge, which is currently being evaluated. Stabilizers are required for high state of cure and better heat resistance.

Fillers run pretty much the full range. A wide variety of carbon blacks, clays, and silicas can be used to improve processing, increase modulus and hardness, and reduce elongation. Fillers are used in relatively small quantities since plasticizers are not generally used.

Curing agents used include peroxides, radiation, and some polyfunctional amines. The polyamines are preferred, and since unmodified aliphatic polyamines such as hexamethylene diamine or triethylene tetramine proved too scorchy, a blocked diamine such as hexamethylene diamine carbamate (Diak No. 1) was recommended. Added safety was claimed for compounds using a combination of Diak No. 1 and Copper Inhibitor 65.

The latest thinking on the new partial replacement for natural rubber, ***Cis*-4 Polybutadiene,** was given to the group by Mr. Railsback. After studying stereo-specific catalyst prepared polymers for several years, Phillips has concentrated on linear polybutadienes of high *cis* configuration. The report indicates that cures were varied to obtain tight cures as indicated by cross-linking, and that the resulting vulcanizates give modulus and hardness comparable to SBR and No. 1 smoked sheets, but are inferior to these polymers in processing characteristics.

It was found, however, that blending *cis*-4 polybutadiene with natural rubber in 1:1 ratio gave compounds with good processing characteristics and with excellent hysteresis properties. These blends have been checked in the laboratory as well as in truck tires.

Using up to 50% of *cis*-4 polybutadiene to replace natural rubber in truck tires was reported to have been tried in numerous retread tire tests. The stocks used were claimed to be cooler running and superior to natural rubber in abrasion resistance in service.

Since the raw material for commercial production of *cis*-4 polybutadiene can be obtained readily, the report concludes that commercial production of the polymer appears feasible and should help alleviate any shortage of natural rubber and have a stabilizing effect on the price of natural.

A special "special-purpose rubber" was introduced to the meeting by Mr. Savage in his paper, **"New Development in Silicone Rubber (Nitrile Silicone)."** Assuming that silicone rubber is considered to be a special polymer itself, Mr. Savage said he wished to narrow the field to General Electric's new nitrile-silicone rubber.[2] This innovation was announced last August (1958), but production for samples and commercial development was announced in this paper. The history of this development was traced in this report along with some of the outstanding properties of the nitrile silicone vulcanizates.

A description was furnished of the three compounds which will be made available this year. Called NSR-X8701, NSR-X4803, and NSR-X5602, these three compounds will give a range of cured properties for trials of this new member of the silicone rubber family. Price will be relatively high initially, but later will depend upon acceptance and use volume by the industry. These compounds will differ in hardness and will also have varying degrees of oil swell resistance.

Another of the newer silicones was described by Mr. Konkle, in his paper, **"Silicone Special-Purpose Polymers."** After a review of silicones in general with a history of the development and some of the early modifications, he brought the group up to date on fluorosilicones. While the fluorosilicones retain the high- and low-temperature resistance of general-purpose silicone rubbers, they are superior in solvent resistance.

The fluorosilicone rubbers have already been put into service and have stood up well in aircraft seals in contact with fuels, oils, and hydraulic fluids.

In a final section of his paper, Mr. Konkle described the method for obtaining room temperature-curing silicones. When the polymer is modified with hydroxyl groups and then mixed with silicone rubbers containing hydrogen or alkoxy groups in the presence of organo-metallic compounds, vulcanization equivalent to that obtained with peroxides and heat was obtained. These compounds are sold in two component mixes with all of the organo-metallic catalyst in one component. They are used for calking and sealing in the aircraft industry. They are also used for potting or encapsulating electrical equipment and are used as a flexible mold material.

[1] RUBBER WORLD, Mar. 1959, p. 890.
[2] *Ibid.*, Sept., 1958, p. 904; Mar., 1959, p. 896.

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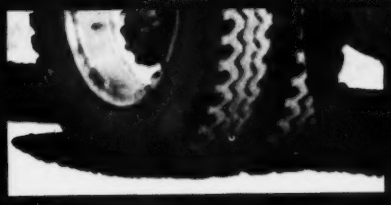
to here 

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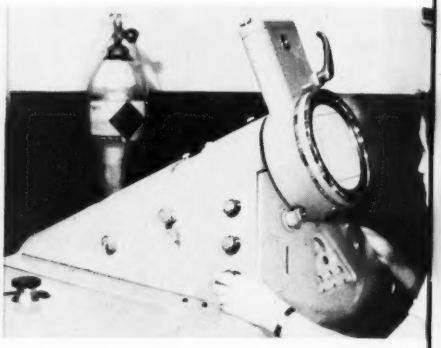

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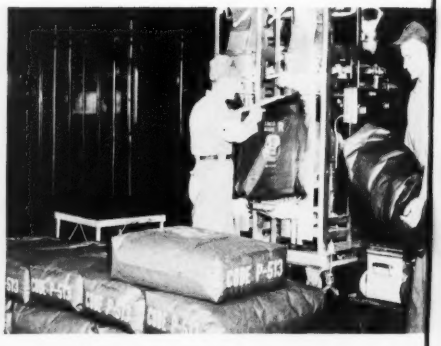

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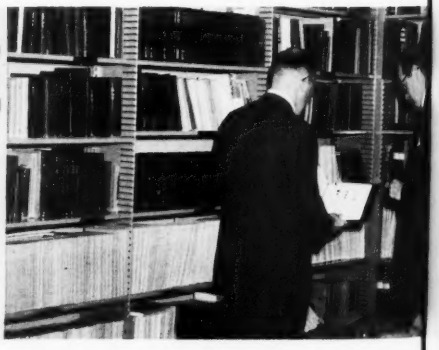

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International Rubber Conference Program Completed; 76 Papers To Be Presented

The International Rubber Conference,[1] sponsored jointly by the Division of Rubber Chemistry, American Chemical Society; Committee D-11 on Rubber and Rubber-Like Materials, American Society for Testing Materials; and the Rubber & Plastics Division, American Society of Mechanical Engineers, to be held at the Shoreham and Sheraton Park Hotels, Washington, D.C., November 8-13, 1959, has completed its program of more than 75 papers for this meeting. There will be 12 technical sessions from Monday through Friday with concurrent sessions planned for Wednesday afternoon, Thursday morning and afternoon. There will be no sessions on Tuesday afternoon.

Among the several subjects of these various technical sessions are the following: Equipment and Processes in Rubber Manufacturing, Elastomers as Engineering Materials, Tires, Advances in Test Methods, Elastomer Reinforcement, Vulcanization, Rubber and Latex, and Polymer and Polymer Structure.

A. E. Juve, B. F. Goodrich Co. Research Center, is chairman of the administrative committee for the Conference; B. S. Garvey, Jr., Pennsalt Chemicals Corp., is chairman of the program committee; and A. W. Sloan, Atlantic Research Corp., is chairman of the local committee on arrangements.

An exhibit of testing equipment will be held during the Conference. Dr. Norman Bekkedahl, National Bureau of Standards, Washington, is in charge of this project.

The titles and authors for the various sessions are given below. Abstracts of these papers will be published in future issues of RUBBER WORLD.

International Rubber Conference Technical Program

Session No. 1—Monday Morning, November 9

1. Introduction to the Conference.

Equipment and Processes in Rubber Manufacturing

2. The Rotomil—A Continuous Mixing Device. A. E. Juve, J. R. Beatty, Goodrich Research Center, Brecksville, O., and R. H. Kline, National Rubber Machinery Co., Akron, O.

3. New Rubber Processing Techniques for the '60's. A. H. Hale, Hale & Kullgren, Inc., Akron.

4. Basic Equipment for Producing Flexible and Rigid Polyurethane Foams. J. M. Buist, Imperial Chemical Industries, Ltd., Manchester, England.

Elastomers as Engineering Materials

5. Elastomers in Naval Machinery. E. M. Herrman, J. S. Post, and S. U. Patton, U. S. Naval Engineering Experiment Station, Annapolis, Md.

6. Urethane Polymers as Engineering Materials. J. G. DiPinto, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

7. Effect of Composition on Flow Properties of Polymeric Sealants. J. Gaynor, G. W. Blum, E. G. Babolek, C. P. Alexander, Case Institute of Technology, Cleveland, O.

Session No. 2—Monday Afternoon, November 9
Tires

8. What Bladderless Curing of Tubeless Tires Can Mean in Increased Productivity. George N. Murphy, National Rubber Machinery Co.

9. Worldwide Developments in Tire Production. C. A. Litzler, C. A. Litzler Co., Cleveland, O.

10. Aircraft Tire Testing Developments. H. P. Lamb, Adamson United Co., Akron.

11. Power Wastage in Tires. G. B. Roberts, Dunlop Rubber Co., Ltd., Manchester.

12. Power Loss and Operating Temperature of Tires. R. D. Stiehler, M. N. Steel, G. G. Richey, J. Mandell, R. N. Hobbs, National Bureau of Standards, Washington.

13. The Mechanical Behavior of the Tire in Dependence on Materials and Construction. W. Hofferberth, Deutsche Dunlop Gummi Co. AG., Hanau a. Main, Germany.

14. Stresses in Deflected Tires. W. F. Ames and H. G. Lauterbach, Du Pont.

Session No. 3—Tuesday Morning, November 10
Tires

15. Retreading of Tires. H. Geldof, Rubberinstituut T. N. O., Delft, Netherlands.

16. A Towing Device for Estimating Road Wear. L. P. Gelinas and E. B. Storey, Polymer Corp., Ltd., Sarnia, Ont., Canada.

17. An Indoor Tester for Measuring Tire Treadwear. G. G. Richey, J. Mandell, and R. D. Stiehler, National Bureau of Standards.

18. Measurement of Tread Motion and Application to Tire Performance. H. H. Vickers and S. B. Robison, Esso Research & Engineering Co., Linden, N. J.

19. International Road Testing of HAF and ISAF Blacks in Passenger Tires. O. F. K. Bussemaker, N. V. Ruberfabriek Vredestein, Enschede, Netherlands; E. M. Dannenberg, Godfrey L. Cabot, Inc., Cambridge, Mass.; C. Prat, Institut Français du Caoutchouc, Paris, France; H. Westlinning, Degussa A. G., Kalscheuren, Germany.

20. The Role of Hysteresis in Tire Wear and Laboratory Abrasion. A. Schallamach, British Rubber Producers Research Association, Welwyn Garden City, England.

21. A Theory of the Abrasion of Rubber. F. W. Boggs, United States Rubber Co., Wayne, N. J.

Session No. 4—Wednesday Morning, November 11
Advances in Test Methods

22. Micro-Hardness and Micro-Rebound Measurements. S. Oberto (to be presented by a colleague), Pirelli Rubber Laboratories, Milan, Italy.

23. Micro-Hardness Testing—Its Possibilities and Limitations. A. L. Soden and J. R. Scott, Research Association of British Rubber Manufacturers, Shawbury, England.

24. New Artificial Weathering Methods. G. F. Bush, G. F. Bush Associates, Princeton, N. J.

25. The Natural and Accelerated Ozone Aging of Elastomer Compounds. M. M. Lowman, Goodyear Tire & Rubber Co., St. Marys, O., and H. P. Miller, B. F. Goodrich Co., Cadillac, Mich.

26. Viscosity and Relaxation Measurements on Crude Rubbers and Compounds. S. Eccher, Pirelli Rubber Laboratories.

27. Aging of Rubber Vulcanizates. J. Mandell, F. L. Roth, M. N. Steel, and R. D. Stiehler, NBS.

28. The Charles Goodyear Medal Lecture of the Division of Rubber Chemistry, American Chemical Society.

Session No. 5—Wednesday Afternoon, November 11
Test Methods

29. Standards for Rubber Compounding. F. L. Roth and R. D. Stiehler, NBS.

30. Sulfur Group Analysis in Natural Rubber Vulcanizates. M. L. Studebaker and L. G. Nabors, Phillips Chemical Co., Akron.

31. The Stress-Strain Behavior of Elastomers at Different Velocities of Deformation. G. Fromandi, R. Ecker, and W. Heideman, Farbenfabriken Bayer A. G., Leverkusen, Germany.

[1] RUBBER WORLD, May, 1958, p. 279.

Classification

32. A Practical Method of Classifying All Elastomeric Vulcanizates. N. L. Catton, Du Pont, and R. C. Edwards, Chrysler Engineering Corp., Detroit, Mich., and T. M. Loring, Michigan Precision Molded, Inc., Walled Lake, Mich.

Statistical Methods

33. The Use of Regression Techniques in Elastomer Compounding. P. F. Bertsch, Du Pont.

34. Modern Quality Control. S. Collier, Johns-Manville Corp., New York, N. Y.

Session No. 6—Wednesday Afternoon, November 11
Theory

35. Measurement and Interpretation of the Rate of Volume Swell and Equilibrium Volume Swell in Cross-Linked Networks. D. J. Buckley and M. Berger, Esso Research.

36. Longitudinal Tearing of Vulcanizates in Extension—II. Tests of Various Elastomers in a Limited Range of Temperature and Speed. R. Chasset and P. Thirion, Institut Francais.

37. The Measurement of Flow and Slip Velocity with the Shearing Disk Viscometer. M. Mooney, U. S. Rubber, Wayne.

38. Response of an Elastomer to Any Forcing Function. M. Berger, Esso Research.

39. Some Statistical Considerations Underlying Molecular Theories of Rubber Elasticity. Jacob Muzur and Turner Alfrey, Jr., Dow Chemical Co., Midland, Mich.

Session No. 7—Thursday Morning, November 12
Elastomer Reinforcement

40. Reinforcement of Rubber by Fillers. E. Andrews, L. Mullin, and N. R. Tobin, BRPRA.

41. Elastomer-Filler Interactions. J. P. Berry, P. J. Cayre, and M. Morton, University of Akron, Akron.

42. Interactions of Hydrocarbons and Powders. W. C. Wake, RABRM.

43. Mechanico-Chemical Reactions Leading to Reinforcement in Rubbers. R. J. Ceresa, National College of Rubber Technology, London, England.

44. Oxidation of *Hevea* Vulcanizates Containing Carbon Black. E. M. Bevilacqua, U. S. Rubber, Wayne.

45. Swell Resistance of Polymer Filler Systems to Boiling Water. S. Palinchak and W. J. Mueller, Battelle Memorial Institute, Columbus, O.

46. Selection of Process and Extender Oils with Minimum Staining Characteristics for Use in Rubber. J. S. Sweeley, J. B. Ziegler, R. W. King, S. S. Kurtz, Jr., Sun Oil Co., Marcus Hook, Pa.

Session No. 8—Thursday Morning, November 12
Natural Rubber and Latex

47. Preservation of Natural Rubber Latex in the Field. J. S. Lowe, Dunlop Malayan Estates, Ltd., Batang, Malaka, Malaya.

48. Modern Large-Scale Production of *Hevea* Rubber and *Hevea* Latex Concentrate. G. Verhaar, Firestone Plantations Co., Harbel, Liberia.

49. Recent Developments in the Production and Processing of Natural Rubber in Malaya. J. E. Morris and B. C. Sekhar, Rubber Research Institute of Malaya, Kuala Lumpur, Malaya.

50. Towards the Standardization of Natural Rubber—Present Trends. M. Liponski and Vu-Dinh-Do, Institut des Recherches au Viet-Nam.

51. Physiology as a Help to Improvement of Yields of *Hevea*. J. Le-Bras, Institut Français du Caoutchouc.

Session No. 9—Thursday Afternoon November 12
Vulcanization

52. Properties of Compounds Relative to Vulcanization. J. H. Gifford, Witco Chemical Co., Akron.

53. Estimation of State of Cure of Elastomers by Means of Radioactive Sulfur. H. L. Pederson, Nordiske Kabel-OG Traadfabriker, Copenhagen, Denmark.

54. Chemical Interpretation of Dicumyl Peroxide Vulcanization. L. O. Amberg and W. D. Willis, Hercules Powder Co., Wilmington.

55. Chemistry of Vulcanization of Viton, A Fluorocarbon Elastomer. J. F. Smith, Du Pont.

56. Crystallization and Cure Studies of Neoprene W Using Dielectric Measurements. M. Hanok and I. N. Cooperman, New York Naval Shipyard, Brooklyn, N. Y.

57. Investigation of Radical and Polar Mechanism in Vulcanization Reactions. J. R. Shelton and E. T. McDonel, Case Institute.

58. Contrasts in the Response of Elastomers to High-Temperature Vulcanization. F. B. Smith, Naugatuck Chemical Division, U. S. Rubber, Naugatuck, Conn.

Session No. 10—Thursday Afternoon November 12
Rubber and Latex—Synthetic and Natural

59. Recent Developments in Superior Processing Rubber. H. C. Baker, BRPRA.

60. Factors Influencing the Stability of SBR Latex. F. A. Sliemers, B. Bennett, P. B. Stickney, G. Heiligmann, Battelle Memorial Institute.

61. The Colloidal Properties of Synthetic Copolymer Latices. C. F. Fryling, Koppers Co., Inc., Verona, Pa.

62. Latex Masterbatching — Compounding, Development, Future Possibilities, and Influence on Rubber Manufacture. I. Drogin, United Carbon Co., Inc., Charleston, W. Va.

63. Stability Testing of Natural and Synthetic Latices. J. L. M. Newnham and D. J. Simcox, Dunlop Rubber Co., Ltd., Birmingham, England.

64. A Strain Test for Latex Films and Its Application. P. R. Gyss and C. E. Wu, Socfin Co., Ltd., Kuala Lumpur.

Session No. 11—Friday Morning, November 13
Polymer and Polymer Structure

65. Elastomeric Succinic and Anhydrosuccinic Derivatives of Natural Rubber. C. P. Pinazzi and G. Milbert, Institut Français du Caoutchouc.

66. *Cis-Trans* Isomerization of Natural Polyisoprenes. J. I. Cunneen, BRPRA.

67. Polymerization of Vinyl Monomers in Rubber Latices. P. W. Allen, C. L. M. Bell, E. G. Cockbain, R. B. Mumford, BRPRA.

68. Properties of Tin Elastomers. J. C. Montermoso, T. M. Andrews, L. P. Marinelli, and B. LaLiberte, Quartermaster Research & Development Center, Natick, Mass.

69. Silicone Rubber—Today and Tomorrow. P. C. Servais and K. E. Polmanteer, Dow Corning Corp., Midland.

70. The Structure of Chlorosulfonated Polyethylene. A. Nersasian and D. E. Anderson, Du Pont.

71. Properties of Chlorosulfonated High-Density Polyethylene. P. A. Peffer, J. B. Knox, J. Kalil, R. R. Radcliffe, Du Pont.

Session No. 12—Friday Afternoon, November 13
Rubber Chemicals

72. A Study of the Behavior of Selected Derivatives of p-Phenylene Diamine in Rubber Compounds. J. T. Watts, Imperial Chemical Industries.

Adhesion

73. Studies on the Mechanism of Adhesion in Polymeric Systems. S. B. Robison and D. J. Buckley, Esso Research.

74. Some Aspects of Rubber-Textile Adhesion. G. M. Doyle, Dunlop Rubber Co., Ltd.

Polyurethanes

75. Relation of Structure to Properties in Polyurethanes. E. F. Cluff and E. K. Gladding, Du Pont.

76. Reactions of Diisocyanate in Water Systems. M. E. Bailey, C. E. McGinn, and S. E. Berger, Allied Chemical Corp., Buffalo, N. Y.

77. Problems Pertaining to Prepolymer Preparation. C. E. McGinn, Allied Chemical.

Urethanes Topic of Technical Meeting; Inflation Subject after Dinner at NYRG

The current status of **liquid urethane elastomers** was provided by J. S. Rugg, elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., as the first talk of the technical session of the New York Rubber Group's spring meeting, March 20, at the Henry Hudson Hotel, New York, N. Y. Liquid urethane elastomers derive their name from the chemical grouping obtained by the reaction of an isocyanate with a hydroxyl bearing compound and are the result of a long period of research. Hanford and Holmes here and Bayer in Germany first recognized the commercial importance of urethanes about 20 years ago. Wide publication of work done in Germany in the later 1940's on condensation polymers based on diisocyanates focused attention on liquid urethane polymers as interesting new elastomers.

Intensive development work in the last seven to nine years, said Rugg, has taken liquid urethane elastomers from the test-tube stage to the commercial stage, with an estimated consumption of 750,000 pounds in 1959 and from two to four million pounds in 1960.

Liquid Urethane Advantages

These elastomers, said Rugg to the more than 200 guests and members present, offer (1) superior performance characteristics and (2) methods of fabrication which are less costly and more easily adapted to automatic production and modern materials handling techniques. Experience shows that liquids are by far the most economical form to use in processing large volumes of materials.

The properties of liquid urethane elastomers, such as Du Pont's Adiprene L, make them well suited for high-performance molded goods. End-product service tests have shown excellent performance in solid tires, heel lifts, and shoe parts, pump impellers and bodies, rolls, dust and oil seals, vibration dampers, and belting. High load bearing capacity coupled with extensibility, resilience, and impact strength are other properties to be considered in application engineering.

The desired physical properties are obtained by changing the type and the ratio of reactants used to synthesize the urethane elastomer in the mold. A large opportunity exists for liquid urethane elastomers in fields other than high-performance molded goods.

In the plant, continued Rugg, processing costs are reduced by three means. Raw material and in-process inventories are cut down; capital expenditures for equipment are reduced; and the number of physical operations is lessened. The heart of a practical liquid elastomer process is the mixing machine. Mixing machinery of design suitable for continuous or intermittent operation had to be developed before the large-scale use of liquid urethane became feasible. Relatively low-cost commercial mixing equipment is now available which will heat, degas, mix polymer and curing agent, and disperse mixed material at the rate of two to ten pounds per minute. Such equipment could be used in a process which might produce as much as 100 pounds of molded goods per hour and could be operated by one man. Molds may be filled by simple casting, compression, transfer or injection molding, and by centrifugal or rotational methods.

Future advances in processing equipment and know-how are expected, summarized Rugg. Mixing equipment is expected to be developed which will permit compounding liquid urethane stocks by push-button methods. The future lies with the rubber manufacturing industry in partnership with the polymer supplier.

Urethane Coatings

"Isocyanate Reactive Coatings" was the topic of the second speaker, M. W. Bailey, manager, isocyanates applications research, National Aniline Division, Allied Chemical Corp., Buffalo, N. Y. Isocyanates are noted for their reactivity with compounds containing active hydrogen atoms. Combinations of isocyanates and polyols give exothermic equilibrium reactions which will convert into films upon contact with the air. On the basis of that which is known now about kinetics of these reactions, considerable control can be exercised to get a desired result by proper selection of reaction conditions.

A number of isocyanates as well as corectants are available. Because of the wide choice of reactants, polymers possessing a wide range of properties can be produced. Many of these polymers show useful properties as surface coatings because of their chemical and abrasive properties. The coatings discussed by Bailey were used particularly as coatings for flexible and rigid substrates—for thin-gage sheet metal, paper, leather, and other materials.

Urethane Foams

In the third talk, **"Flexible Urethane Foams"**, J. D. Mahoney, director of marketing, Mobay Chemical Co., Pittsburgh, Pa., predicted that 70 million pounds of basic chemicals will be produced by the fast-growing urethane industry this year. Approximately 38 million pounds of urethane raw materials were produced in 1958. For 1959 he predicted a range of from 45 to 95 million pounds of urethane foam; for 1964, a range of 200 to 300 million pounds of urethane foam is expected to be produced.

Mahoney attributed much of the urethane industry's present market growth to improved technology of manufacturing processing, higher quality standards, and an increased awareness of application advantages. More than two-thirds of the top 50 furniture manufacturers are now using urethane foams in all or part of their upholstered lines; the top four automobile companies are using the foam for cushioning, insulating, and padding; and the top three American jet airliner manufacturers are specifying urethane foam as a generous portion of their cushioning and insulating requirements. Other uses being tested include urethane foam mattresses, protective packaging for optical instruments and missile components, and binders for solid rocket propellents.

Such new developments as the one-shot polyether foaming system and new molding techniques have given product manufacturers the benefit of mass-pro-

Technical meeting speakers (left to right): M. W. Bailey, J. S. Rugg, James D. Mahoney, before New York Rubber Group

duction systems that are faster, simpler, and more economical. In the four-year period since urethanes first went into commercial production here, the price of chemical raw materials used in urethane foams has been cut nearly in half, and this trend is expected to continue in the future. First-quarter sales of urethane chemicals produced by Mobay are running 94% ahead of 1958, he concluded.

Inflation and R&D

The dinner speaker was Ellis B. Gardner, Jr., vice president, Hewitt-Robins, Inc., Stamford, Conn., who chose **"Inflation and How It Affects Research and Development"** as his topic. The inflationary trend in wages, the rise in the cost of Big Government, and the growth in new product development are the three most powerful forces which have recently had a combined impact on corporation finances and economics. Research and development has a direct interrelation with wage inflation and governmental deficit spending, and the connecting link is corporate profits, Mr. Gardner said.

Profit margins for the nation's industrial companies have long been on the decline, and federal and state deficit financing has produced steady inflation, lowering the value of the dollar and raising the cost of the goods and services which industry supports, relative to their cost manufacture by other nations. Also, labor union leaders are talking of their 1959 wage demands in confident tones and are lobbying for price controls by the government. The percentage return on industrial investment and the percentage return on sales of all industry have been progressively declining, and the rubber industry has fared worse than industry as a whole.

Labor and government costs have thus put an intense squeeze on profits. A corporation's treasurer must do four things with reported earnings. First, he must pay a heavy tax to the government, which amounts to 52% of the reported pretax profits, not including the state and municipal taxes. Second, he must pay off current repayment obligations, which payment comes out of after-tax earnings. Third, the corporation has an obligation to pay dividends to its stockholders. Fourth, what is left is reinvested into the business.

Management problems in corporation finance have been intensified in geometeric proportions by the developments of research programs, it was said. Management's first dilemma relates to the plant and equipment required to produce the products which research develops. If the product is relatively simple to produce, caution must be exercised because the product may be produced on a more economical basis by garage shops. If the new product requires extensive plant and equipment, it must be paid for from profits or from a new issue of securities. It is better to provide for the new plant with reinvested capital, but shrinking profit margins on sales make this alternative difficult always to achieve.

If you plan on sales of $1,000,000 per year in the rubber industry, generally you must plan on having about $200,000 tied up in the inventories (raw, process, and finished) and $150,000 owed to you at any one time by your customers, Mr. Gardner declared. Include the effect of inflation and you would need not $1,000,000, but $1,100,000. In the rubber industry the interplay of volumes and the occasional relatively low labor content of its product can result in unit costs and unit prices which buck the inflationary trend, but, conversely, the threat of obsolescence and the high fixed charges of running a half empty plant have more adverse reactions.

Threatening trends today to corporate enterprise can be summarized as follows: (1) pressure from labor monopolies for more wages and benefits out of proportion with labor's contribution; (2) pressure for more free government aid, at the price of deficit financing, enhancing an inflationary spiral; (3) steadily narrowing profit margin resulting from intense competition, a competition heightened by new product developments; (4) the rising need of increased profit margins to permit basic research, to permit going off on a few tangents, and to permit a few mistakes in new product development, and (5) the rising crescendo of new product developments requiring more and more funds to produce and market them.

In summary, we are headed for a period where research developments are going to be hard to bring to full-scale production because the labor monopolies and Big Government are taking the wherewithal corporations should have for financing their new projects, according to this speaker. It is bound to lead to increasing difficulty for the corporations to compete abroad, and it may well lead to government ownership of industry in this country. If we are not able to take advantage of the rosy economic and technological future of the Sixties, we will have brought it on ourselves, Mr. Gardner concluded.

After-dinner speaker, E. B. Gardner

Following Mr. Gardner's talk there was a prize drawing for five transistor radios and a portable television set. One of the winners of a radio was Mr. Mahoney, of Mobay.

N. Y. Section, SPE, Vinyl Subgroup Meets

The New York Section of the Society of Plastics Engineers, Inc., held its second meeting of 1959 on March 18 at the Governor Clinton Hotel, New York, N. Y., with approximately 200 in attendance. In addition to the regular meeting of the section, a recently formed Vinyl Professional Activities Committee met.

Moderating the VIPAC meeting on the "Requirements of Pigments for Vinyl Processing" was Melvin M. Gerson, technical service manager, pigment division, Sandoz, Inc., New York. Subsequent speakers were L. R. Sherman, Imperial Color Chemical & Paper Corp., Glens Falls, N. Y., who spoke on "Selected Inorganic Colorants for Vinyl"; and R. H. Zabel, manager, plastics and elastomers section, E. I. du Pont de Nemours & Co., Inc., Chestnut Run, Del., who discussed "Monastral Red and Violet Pigments —Vinyl Applications." Summaries of these talks follow.

The primary requirement for pigments in vinyls, said Gerson, is proper incorporation into the vinyl stock. This is accomplished by the process of dispersion, which separates the individual pigment particles and coats them with a layer of organic vehicle. Proper dispersion assures the processor of full color value of the pigment, streak-free colors, and a minimum of pigment problems such as crocking.

Mr. Sherman commented that vinyl pigmentation requires careful control to obtain the best functionality in dispersion, chemical and heat resistance, weathering, interior exposure, and value. A record of evaluations concerning the above points has been produced in terms of color photographs, and was shown.

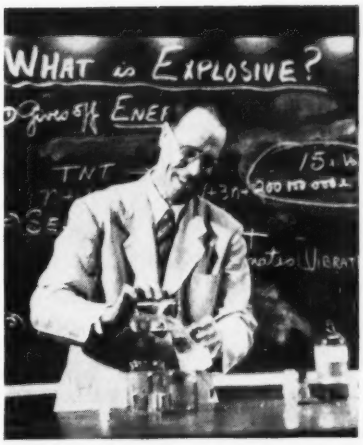
Improvements in dispersion through modification of particle surfaces were demonstrated for chrome yellows and

molybdate oranges by Sherman. Improved dispersion by deaggregation was demonstrated for Mercadium Reds. The bleed resistance of inorganic colors was demonstrated, and some aspects of heat resistance were shown. The weathering of inorganic pigments in vinyl was examined in terms of Fadeometer and Weatherometer exposure. He concluded his talk with a discussion of certain economic aspects of vinyl pigmentation.

For years, stated Mr. Zabel, the phthalocyanine pigments, because of their combination of properties, have been standards for judging the performance of all other organic pigments. Du Pont's pigment department in its search for pigments possessing phthalocyanine properties chose to investigate new chemical types.

After a decade of search, success was realized in derivatives of the linear quinacridone. Three new pigments were developed: Monastral Red Y, a yellow shade fairly opaque red; Monastral Red B, a dark blue shade transparent red; and Monastral Violet R, a red shade transparent violet.

In vinyl these pigments offer outstanding intensity in pastel shades, excellent resistance to heat and light at all concentrations, outstanding chemical resistance, and excellent resistance to crocking and migration, according to Zabel. These pigments are truly unique, not because of any single property, but because of their unique combination of properties. They should fill a real need in the quality conscious vinyl industry, this speaker concluded.



Hubert N. Alyea

Fission and Fusion For Peace Described

The growth of ideas which led to the tapping of nuclear energy for war and peace was traced for the Detroit Rubber & Plastics Group, Inc., by Prof. Hubert N. Alyea, Princeton University, on February 6. He used a variety of spectacular experiments to demonstrate the differences between chemical reactions of fission and fusion. Reactions in atomic bombs and nuclear reactors were compared, and various peacetime uses for radioisotopes were compared. Professor Alyea's lecture, "Fission and Fusion: Weapons for Peace," has been given to many groups as well as numerous radio and television presentations.

This winter meeting of the DRPG was held February 6 at the Leland Hotel, Detroit, Mich. Professor Alyea was the after-dinner speaker, and the technical session preceding the dinner featured a talk by David Spalding, General Electric Co., Waterford, N. Y., on the new nitrile silicone rubbers.[1] Dr. Spalding traced the development of these elastomers which G-E announced in August, 1958, and gave the Group detailed properties of the three grades that will be made commercially available.

About 200 members attended the meeting which also included an oyster bar in the predinner festivities, courtesy of O'Connor & Co., Chicago, Ill. During the dinner an announcement was made that both an advanced lecture course and a laboratory course in rubber technology would be offered during the spring semester at Wayne State University.

[1] RUBBER WORLD, Sept., 1958, p. 904.

Making of Specific Cyanosilicones

Cyanosilicones that can be tailored to a specific end-use were described by Everett W. Bennett, Union Carbide Silicones Division, New York, N. Y., speaking to the Elastomer & Plastics Group, Northeastern Section, ACS, on February 17, in Cambridge, Mass. Dr. Bennett first discussed the structure and method of production of these elastomers and then went on to show how they can be tailored-to-fit as well as some of the outstanding properties obtained.

The process for making these elastomers must be very closely controlled. All raw materials must be highly purified, and acid content is controlled in all steps. Using tri-phenyl phosphorous or platinum-carbon catalysts, the formation of the most common cyanodialkylchlorosiloxanes was illustrated, and several methods of hydrolysis of these materials to dimers and trimers were shown. The hydrolyzates are purified by distillation or depolymerization to remove mono- and tri-functional molecules that might end-block or cross-link the polymer prematurely.

By copolymerization of the cyano compounds with siloxanes, and the addition of proper end-blocking and cross-linking molecules, cyanosilicones are produced for specific end-use or properties.

Properties indicated for these elastomers show them to be very good in heat resistance although a few forms are slightly less heat resistant than conventional silicones. The cyanosilicones are also claimed to be superior in low-temperature resistance and have less swell in solvents than most materials. The solvent swell can be adjusted by "tailoring" the elastomer, thus making it resistant to specific solvents.

A look into the properties of cyanosilicones in ASTM oils and fuels was also included in the talk, and the conclusion drawn that cyanosilicones would soon find use in pastes, adhesives, sealants, elastomers, calking materials, and liquids.

Dr. Bennett's talk, "Cyanosilicone Rubber Chemistry," was given after the regular cocktail hour and dinner-meeting of the Group, with 75 members and guests in attendance.

ASME Rubber & Plastics Program on Tire Cord

The Rubber & Plastics Division of the American Society of Mechanical Engineers will have a one-day, two-session program at the semi-annual meeting of the parent Society in St. Louis, Mo., during the week of June 15. R. D. Stiehler, National Bureau of Standards, Washington, D. C. is chairman of the Rubber & Plastics Division.

The first technical session will consist of a paper by George M. Sprowls, director of research, Tyrex, Inc., and a color sound movie on recent road tests of tires made with Tyrex cord. The title of the paper is **"Tires and Tire Cords."** This session will conclude with a panel discussion.

The second session will consist of additional papers on tires and tire cord as follows:

Tire Testing. John W. Hannell, Jr., E. I. du Pont de Nemours & Co., Inc., Newport, Del.

Preparation and Processing of Nylon Tire Cord. James W. Bolmeyer, Du Pont, Wilmington, Del.

Engineering Reduced-Ply Tires. Donald H. Heckert, Du Pont, Wilmington.

Recent Developments in Tire Reinforcing Materials Other Than Rayon and Nylon. C. A. Litzler, C. A. Litzler Co., Cleveland, O.

Solid Rocket Propellant Manufacture Described

A pictorial presentation of the manufacture of case-bonded, castable composite solid rocket propellant engines was shown to the Connecticut Rubber Group at its meeting on February 13 by Frederick Mueller, Thiokol Chemical Corp., Trenton, N. J. The picture series started with the case preparation, followed by the mixing and preparing of the binder, oxidizer, and propellant, and then went through the various steps involved in casting and curing the rocket propellant.

Mr. Mueller started his talk by reviewing for the Group the history of the Thiokol company, starting with liquid polymer development. He gave some history on the entry into solid rocket fuels and some figures on the recent growth of the rocket divisions.

In a summation of the types of rocket fuels, the field was divided into two classifications: (1) liquid types which include pure liquids and also liquefied gases, (2) the solid types which are divided into double-base and composite. The composite group is further divided into castable and extruded. Some of the advantages and disadvantages of the various types were included in the talk. It was at this point that the film strip was shown tracing the manufacture of this castable propellant.

The last two portions of the talk were devoted to some information on design of rocket propellant engines and the development of propellant formulations. The features considered for engine design are the type of thrust, the amount of thrust, and the burning time desired, and any other considerations of the particular use. The formulations are concerned with gaining greater energy content, a wider range of burning rates, and better extreme-temperature performance.

The talk was made before the Connecticut Rubber Group's regular winter meeting held at Rapp's Paradise Inn, Ansonia, Conn. About 180 members attended the meeting, which also included a cocktail hour and dinner preceding Mr. Mueller's talk.

The next meeting of the Group is scheduled for May 22, at the same location, and will consist of a panel discussion on "The Use of Rubber in Aeronautical Applications."

Injection Molding Praised for Tlargi

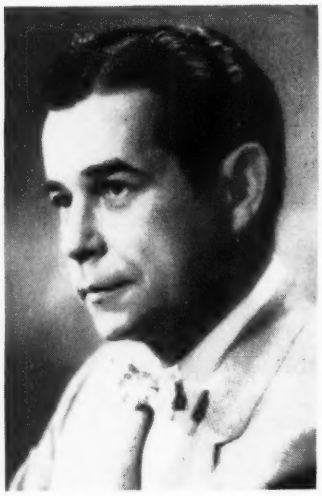
Injection molding of natural and synthetic rubber is possible and practical. Its use will result in lower manufacturing costs and will reduce direct labor, material consumed, and scrap loss. When coupled with trimless molds, the system approaches the ultimate of a fully automatic rubber molding process. These statements were made by E. W. Hollis, The Lewis Welding & Engineering Corp., Cleveland, O. to Tlargi's March 3 meeting.

Mr. Hollis told The Los Angeles' Rubber Group, Inc., that many companies have adopted this method since injection molding equipment has become available and the design of trimless molds to be used with injection molding has been made practical. The injection machine can be fed compound automatically, and its cycle can be controlled to reproduce itself automatically without requiring human supervision or service.

The only problem left for completely automatic rubber molding systems is the removal of the parts from the mold. This must be personalized to each particular part and provides much food for thought by those developing new industrial processes and methods.

Mr. Hollis was the technical speaker for the Tlargi meeting held in the Biltmore Hotel, Los Angeles, Calif., with 270 present. The formal title for Mr. Hollis's talk was "True Injection Molding of Rubber Compounds."

The after-dinner topic that evening was "The Voice of Santa Anita," with Joe Hernandez, speaking on Santa Anita and horse racing. Mr. Hernandez, the race caller at Santa Anita since it opened in 1934, gave the Tlargi members present a very enjoyable talk on the "Horses," but did not present a sure-fire method for picking a winner. Several races were shown in a movie which was presented along with his talk.



Madison Geddes

E. W. Hollis

Buffalo RG Hears About Nitrile Silicones

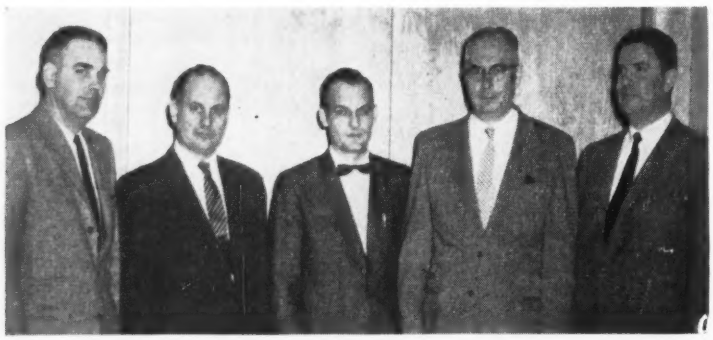
The story on nitrile silicone rubbers[1] was presented to the Buffalo Rubber Group at the meeting held on March 3 at the Westbrook Hotel, Buffalo, N. Y. About 115 members heard B. B. White, General Electric Co., Waterford, N. Y., describe the new silicone modification which has just come on the market.

The nitrile silicone rubbers were first announced by G-E last August, but they have now arrived at the stage in production where samples can be sent out. Mr. White traced the development for the Group and gave some of the properties of these new elastomers which make them of interest to industry.

Following dinner, which incidentally set an attendance record for the Buffalo Group, Gunter Haase, Bell Aircraft Corp., gave the Group some points in the "Conquest of Space." Dr. Haase, a pioneer in rocketry, took the members on a fascinating verbal interplanetary journey, at an escape velocity of 35,000 feet per second.

Assuming these celestial travelers return to terra firma, the next Buffalo Group meeting is the annual Joint International Meeting with the Ontario Rubber Section, CIC, on May 1, at Niagara Falls, Ont.

[1] RUBBER WORLD, Sept., 1958, p. 904.



Connecticut Rubber Group officers with rocket expert: *(left to right)*: A. Murdoch, Jr., V. P. Chadwick, Frederick Mueller *(speaker)*, W. H. Couch, and F. B. Smith

WASHINGTON REPORT

By JOHN F. KING

S-11 "Good Faith" Bill Still Opposed by Industry

For the fourth straight year the rubber industry finds itself deeply involved in the continuing Senate fight over enactment of the "good faith bill," an aging proposal that has kicked around so long the whole business community automatically refers to it by its Senate bill number, S-11.

The contenders in the battle are the same—the independent retailer *versus* the manufacturer; the issues, it is conceded by all concerned, remain essentially unchanged; and the bill is stuck in the same committee—Senate Judiciary—that has formed its prison since 1956.

Legislative Stalemate?

But the battle is just as hard-fought as it ever was.

Because S-11 has become known as hardiest of legislative perennials, it doubtless will remain in issue for the foreseeable future, at least. Even if the Judiciary Committee changes its mind after all these years and lets the bill come to a vote on the floor, the betting is it still would not get the Senate's approval. Yet, because the contenders are so deeply committed for or against the measure, the battle will rage on.

In its simplest terms, S-11 would reverse a 1951 Supreme Court decision interpreting the Robinson-Patman Act as permitting a manufacturer charged with price discrimination by the Federal Trade Commission to defend himself in court with the argument that he made selective price reductions in "good faith" to meet an equally lower price offered by a competitor.

The FTC itself, incidentally, is as divided in the current fight over S-11 as it ever was. Three commissioners favor it; two are opposed to the measure.

As the independent tire dealers see the situation, maintenance of the "good faith" defense leaves the manufacturer free to squeeze out independent competition by predatory price cutting. The rubber manufacturers, on the other hand, claim repeal of the good faith defense would hobble competition by ending the right to cut prices in a limited distribution area to "meet"—not "beat"—competitive prices.

NTDRA and RMA Statements

There seems little doubt that S-11 will get the approval of the Anti-trust Subcommittee of Senate Judiciary, which is now considering the legislation under the chairmanship of Sen. Estes Kefauver (Dem., Tenn.), an S-11 sponsor. It is likely, however, that it will land in the same pigeonhole in the full Judiciary Committee it has occupied for the last couple of years. The Judiciary Committee under the chairmanship of Sen. James Eastland (Dem., Miss.) is just as conservative as ever where business-regulating bills are concerned. The Democratic-liberal sweep in November's Congressional election left the Judiciary Committee remarkably unscathed, largely because the Senate leadership does not want too many "liberals" on the Judiciary panel should civil rights warfare break out again. Judiciary must approve all civil rights bills.

The Kefauver Subcommittee is pushing ahead just the same. In mid-March the panel began new hearings—although the record is jampacked with the testimony of hundreds of witnesses from past years—and the old warriors were back in the arena.

W. W. Marsh, executive secretary of the National Tire Dealers & Retreaders Association, wired Kefauver his group's renewed endorsements of S-11, although he expressed some dismay that the Senator was starting yet more hearings on the bill. Marsh said:

"We believe there is a real and serious need for legislation of this type and yes, legislation that even goes beyond the framework of S-11 to cure some of the problems that face small business today. As a matter of fact, I can give you no more convincing evidence than the fact that we are appearing before a subcommittee headed by Senator Humphrey [Hubert H. Humphrey (Dem., Minn.) of the Senate's Small Business Subcommittee on Distribution and Retailing Practices] on some of the problems in the tire business, and I think that we of the retail tire industry have a great number of problems which are almost impossible to solve."

S-11, he concluded, would have a "very constructive effect on some of these problems."

(Humphrey is planning separate hearings on the independents' complaints about unfair competition from the retail outlets, or company stores, maintained by the rubber manufacturers. The House Small Business Committee in mid-March announced a series of hearings designed to delve into the same issues.)

Telling the manufacturers' side of the story was Ralph W. McCreary, executive vice president of McCreary Tire & Rubber Co., Indiana, Pa., who testified at a Subcommittee hearing March 19 on behalf of The Rubber Manufacturers Association, Inc. The nub of his testimony was that the proponents of the bill were special pleaders who want protection from "the historical hard competition of our free enterprise system."

McCreary based his whole case on two arguments: that since the Supreme Court decision eight years ago, dealers shipped 58% more replacement tires—the total rising from 43 million units in 1951 to nearly 71 million in 1958. The second argument McCreary put forward was that the massive price discrimination S-11 enthusiasts predicted would flow from the High Court's 1951 decision never materialized.

"Eight years' experience under the decision has proved, better than anything we can possibly say, that such decision created no loophole which needs closing by act of Congress," McCreary said.

He added that if S-11 became law, it would (1) restrain competition and lead to price rigidity at the expense of the consumer; (2) reduce the number of potential suppliers in a given market; (3) deny the produce the basic right of economic self-defense; (4) bring financial ruin to many small manufacturers if equally enforced; and (5) restore the "uncertainties and confusions" which existed prior to the 1951 ruling.

Belting Manufacturers Indicted Under Sherman Anti-Trust Act

The Rubber Manufacturers Association Inc., and 10 other corporations were slapped with a federal grand jury indictment early in March, allegedly for violating the Sherman Anti-Trust Act by illegally fixing prices for flat rubber belting used by industries for conveying products from machines or transmitting power to machinery.

Industry Comments

Two of the companies named in the indictment immediately reacted with surprise that the New York grand jury would decide that prices on flat belting are fixed, but generally the firms involved were awaiting a copy of the detailed charges before commenting.

Goodyear Tire & Rubber Co. and The B. F. Goodrich Co. responded to their indictment by pointing out that conveyor and transmission belting prices since the war have been kept at relatively low levels, that there has been no "price uniformity" in the conveyor belt field, and that competition has, in fact, been severe as between competitive producers.

A fuller exposition of the RMA and the company defenses in the case is expected to follow formal arraignment on the charges, which will be made before Judge Edmund L. Palmieri of New York's Southern District Federal Court in New York, N. Y., on March 20.

The Government's Case

In announcing the grand jury's action March 4, Attorney General William P. Rogers said the indictment charges that the defendants "have conspired for the last 10 years to fix and maintain uniform prices, terms and conditions of sale" of industrial belting.

The indictment pointed out that the companies involved, and the trade association representing them, account for more than 95% of all flat belting manufactured in this country, and that their dollar volume of sales on this product alone is about $65 million. The indictment also alleges that with increased mechanization of industrial operations in all lines of manufacture, demand for flat belting is "continually increasing."

Commenting on the return of the indictment, Assistant Attorney General Victor R. Hansen, the government's chief anti-trust enforcer, declared that "this product is clearly of great importance to industry, and is widely used in many applications. Constantly increasing mechanization points up the significance of this flat rubber belting. Price fixing on such a product is a serious matter and clearly warrants criminal prosecution." He continued:

"Among the effects of this alleged combination and conspiracy are, according to the indictment, that price competition among the defendants in the sale and distribution of flat belting has been suppressed and eliminated and purchasers of flat belting have been deprived of a free and competitive market for the purchase of these products."

Companies Involved

Named as defendants in the indictment were the following: RMA, Goodyear, and Goodrich; United States Rubber Co., New York; H. K. Porter Co. (Delaware), Pittsburgh; New York Rubber Corp., New York; American Biltrite Rubber Co., Chelsea, Mass.; Hewitt-Robins, Inc., Stamford, Conn.; Raybestos-Manhattan, Inc., Passaic, N. J.; Acme-Hamilton Mfg. Corp., Trenton, N. J.; and Lee Rubber & Tire Corp., Conshohocken, Pa.

RMA Public Affairs Committee Named

The recently organized Public Affairs Committee of The Rubber Manufacturers Association, Inc.,[1] which will meet regularly to review and analyze legislative proposals considered likely to affect the rubber manufacturing industry, issued its first bulletin on March 16. The RMA appeared before the Senate Judiciary Anti-trust and Monopoly Subcommittee to oppose S. 11, the "good faith" bill, on March 19. The RMA bulletin also mentioned the hearings before the Ways and Means Committee on the subject of Federal Unemployment Benefit Standards and suggested that these hearings would begin on April 7. It was indicated that industry companies wishing to be heard should address the committee clerk.

The RMA Public Affairs Committee is headed by RMA vice president, W. J. Sears, and includes the following industry representatives: Stephen E. Stone, Converse Rubber Co.; David K. Larrimer, Firestone Tire & Rubber Co.; Frank K. Knowlton, Charles F. Burke (alternate), General Tire & Rubber Co.; E. L. Bixby, Goodall Rubber Co.; R. G. Jeter, E. A. Cole (alternate), B. F. Goodrich Co.; John F. Rudy, Goodyear Tire & Rubber Co.; A. V. Constantin, Raybestos-Manhattan, Inc.; Douglas Mueller, Seiberling Rubber Co.; and Lawlor B. Reeves, United States Rubber Co.

[1] RUBBER WORLD, Mar., 1959, p. 898.

URWA Sues NLRB on O'Sullivan Strike

The United Rubber Workers took the National Labor Relations Board to court, March 9, in an effort to have set aside the Board's ruling in the bitterly fought URW strike at O'Sullivan Rubber Corp., Winchester, Va., which has gone on almost three years.

NLRB last year ruled that URW's Local 511 could not picket the O'Sullivan plant because the Winchester union had been decertified as bargaining agent in an NLRB-conducted representation election. The election was conducted among O'Sullivan employes who came to work at the plant after Local 511 went on strike. Local 511 members who went on strike were not permitted, in line with the Taft-Hartley Act, to vote in the decertification contest.

Challenging NLRB's decision as a restraint on free speech, the national Union sued in the Fourth Circuit U. S. Court in Richmond. Arguments began March 9.

The NLRB's position in the suit, as it was in issuing the order to Local 511 to halt its picketing at the plant, is that the Taft-Hartley Act is "controlling" in the case—that is, the 1948 statute specifies "economic strikers" may not vote in decertification elections.

The Union, which looks on the legal issue as a challenge of the economic-strikers provision of Taft-Hartley, has a seven-point argument based on constitutional guarantees of free speech, peaceable assembly, and "petition of the government for redress of grievances."

Legislation that would repeal the Taft-Hartley economic-strikers provision is snarled up in the Congressional battle over labor reform legislation and there is no immediate prospect of its enactment.

Russia Pays Du Pont Old World War Claim

Russia has settled a 15-year-old claim of E. I. du Pont de Nemours & Co., Inc., for technical data on the manufacture of synthetic neoprene rubber. Du Pont officials say privately they are happy to get the $1.5 million settlement, but indicate the company will think twice before it becomes involved with Soviet buyers again.

That the Soviets want to do more business with the big American chemical manufacturer is plain in the announcement of the settlement delivered in the United Nations, March 6, by Vladimir S. Alkhimov, chief of the Soviet Purchasing Commission in the United States. Alkhimov said the Du Pont claim was settled "in an amicable way" in the hope additional purchases could be worked out.

Du Pont is saying nothing official on the subject other than it has col-

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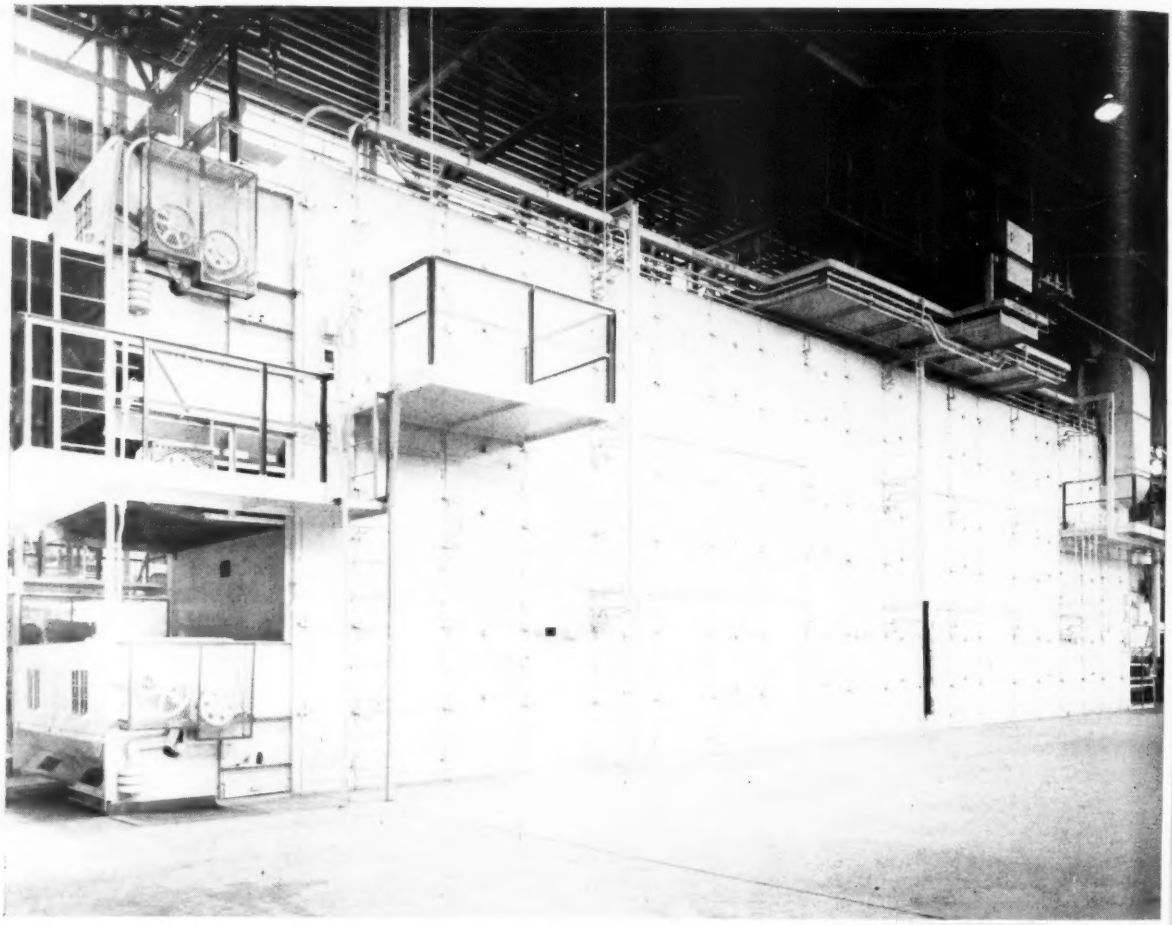

PHOTO COURTESY POLYMER CORPORATION LIMITED, SARNIA, CANADA

POLYMER CORPORATION LIMITED, of Canada, world leaders in development of new applications and new compounding techniques for synthetic rubbers, selected SARGENT to design and build this high volume dryer for their modern new plant at Sarnia. It is believed to be the world's largest gas-fired synthetic rubber dryer . . . and was erected in a record-breaking four weeks.

A direct gas-fired, 3-pass machine, equipped with SARGENT-designed perforated special type stainless steel flight conveyors, it has SARGENT'S exclusive-design breakers, cleaners, and traveling silicone spray devices to provide a perfectly clear conveyor at all times. Dusting and fines are practically eliminated. Downtime for cleanout between runs has been drastically reduced and is kept at a minimum because of SARGENT'S unique housing design. This allows free access to the entire dryer interior through full height hinged doors and quickly and easily removed full height panels which cover the framework.

One of many unusual features of this dryer is that even though the heat source is supplied by only two gas burners, working temperature in the dryer is reached in less than ten minutes from start-up.

Another example of SARGENT modern design and advanced engineering in building dryers to meet varying requirements.

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lected the $1.5 million—reportedly after unsuccessfully seeking $3 million for the technological information it supplied the Soviet government in the allied industrial cooperation program of World War II. But the company will be chary of any new proposals it receives from Soviet buyers. Company officials say they are sticking with the policy of the Manufacturing Chemists Association, which recently declared itself against selling anything to the Russians beyond non-strategic chemical end-products.

Rubber and Chemical Company Exhibits Scheduled for Moscow This Summer

More than a score of rubber and chemical companies will join with the government in participating in the American National Exhibition in Moscow this summer. The show, being staged in Moscow's Sokolniki Park through the summer months, will try to acquaint the Russian people with "Life in America."

Many U. S. Company Exhibits

As of mid-March, more than 250 companies from 24 states signed up to contribute everything from runabout pleasure boats to baby-grand pianos to the American exhibit, according to the government's general manager of the affair, Harold C. McClellan. He expects that by the time the fair opens, the number of firms contributing products and display items will greatly exceed the total so far, and that the Soviet citizen visiting the American show will take in a dazzling array of cultural, scientific, and industrial displays.

The rubber and chemical firms are chipping in on the costs of constructing one of three exhibit buildings scheduled to house the American displays on modern American architecture, sculpture, and photographic art.

The pavilion will be a unique, all-plastic free-form structure sheltering 15,000 square feet, without outer walls, put together with 70 interlocked plastic sections. Each section will resemble an inverted, hexagon-shaped umbrella and will be supported by a 20-foot plastic column. The columns will be hollow to allow drainage of rainwater and will be anchored in concrete. The plastic structure will be flanked by two other exhibit buildings—a gold-anodized aluminum geodesic dome and a glass, steel, and aluminum pavilion. These two structures will house scientific and technological displays.

The plastic pavilion is being built by Lunn Laminates, Inc., Huntington, L. I., and was designed by George Nelson & Co., New York, N. Y. The structure is being shipped to Moscow in sections.

Chemical and Rubber Companies

A partial listing of firms underwriting the costs of the plastic pavilion to date are:

Allied Chemical Corp., New York; American Cyanamid Co., New York; B. F. Goodrich Tire Co., Akron, O.; Brunswick-Balke Collender Co., Chicago, Ill.; Celanese Corp., New York; Dow Chemical, Midland, Mich.; E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; Ferro Corp., Cleveland, O.; Firestone Tire & Rubber, Akron; Food Machinery & Chemical Corp., New York; Foster Grant Co., Leominster, Mass.; General Tire & Rubber, Akron; Goodyear Tire & Rubber, Akron; Hooker Chemical Corp., Niagara Falls, N. Y.; Monsanto Chemical Co., Springfield, Mass.; Owens-Corning Fiberglas Corp., New York; Reichhold Chemicals, Inc., White Plains, N. Y.; Rohm & Haas Co., Philadelphia; Sun Oil Co., Philadelphia; Union Carbide & Carbon, New York; and United States Rubber Co., New York.

Little New Business Expected

While American industrial companies will turn out for the Moscow show in force, there appears little likelihood they can expect much actual business from the affair. Commerce Secretary Lewis L. Strauss says so.

Although the United States exhibition in Sokolniki Park is being managed by the State Department and the U. S. Information Service, it is Strauss's department which sits in judgment of the licensing of U. S. business dealings with the Soviet Union.

At the same time USIS was enthusiastically announcing its progress on the Moscow exhibit in March. The Commerce Secretary was telling the Senate Commerce Committee hearing that he favored as little trade with Russia as possible, as long as the Soviets look on foreign trade as a political weapon.

When Sen. John O. Pastore (Dem., R. I.) ventured the suggestion that the U. S. industrial show in Moscow might stimulate Russian interest in more business with American firms, Strauss reassured him the exhibit is designed to show Russia what American life really is like. He said he didn't see the exhibit as one that would stimulate trade.

Goodyear Gets AEC Work

The Goodyear Tire & Rubber Co., Akron, O., has been awarded a $50,000 research and development contract by the Office of Isotopes Development of the Atomic Energy Commission as part of a program to promote use of radioactive isotopes. Under terms of the contract Goodyear will undertake development and establishment of an isotopic dating technique which will be of value to the rubber and other industries and the public in general.

Isotopic dating methods are expected to have great value in many areas including the determination of the length of storage and service of many military supplies or where code numbers and other markings have been worn away through service. Such methods would be of special value for electronic tubes and circuit components, electrical insulation, and delicate mechanical parts of complex computer systems. In the field of agriculture, such dating techniques would be useful in the dating of seeds for which germination qualities depended upon the time spent in storage.

By measuring the amount of radiation from known radioactive materials, it is possible to compute the age of an item in which the materials are present. Recent development of ultra-sensitive low-level counting devices

Welton Becket F.A.I.A. and Associates, Los Angeles, Calif.

Architect's model of American 1959 exhibit at Moscow fair

makes it possible to monitor extremely low amounts of radiation.

Goodyear's work will be applied to representative pairs of selected isotopes so that one isotope serves as a standard against which to measure the other and thus determine age. A further selection will be made to cover a range of age determinations of from several weeks to 100 years for various products. Results of this work, in connection with AEC's Office of Isotopes Development, will be published and made available to other industries.

INDUSTRY NEWS

Shell Isoprene Rubber 30¢; U. S. Rubber Uses It in Tires

In simultaneous press conferences in New York and Los Angeles, United States Rubber Co. and Shell Chemical Co., on March 10, announced the commercial production of synthetic polyisoprene at a selling price of 30¢ a pound, f.o.b. Torrance, Calif., (Shell Chemical Co.), and the commercial production of 7.50-20 size truck tires at the same price as these tires made with their usual content of natural rubber (U. S. Rubber). The significance of this announcement is that although Firestone Tire & Rubber Co., B. F. Goodrich Co., and Goodyear Tire & Rubber Co., have also been active in the development of synthetic polyisoprene, the man-made duplicate of natural rubber, and have pilot, semi-commercial, or commercial plants built or building, this is the first time synthetic polyisoprene has been offered commercially at a price competitive with natural rubber.

Shell's Synthetic IR

At the press conference in New York the announcements were made jointly by John W. McGovern, president of U. S. Rubber, and Richard C. McCurdy, president of Shell Chemical. In Los Angeles the announcements were made jointly by D. W. Walsh, Pacific Coast sales manager, tire division, U. S. Rubber, and J. P. Cunningham, manager, synthetic rubber division of Shell Chemical.

The commercial availability of synthetic polyisoprene rubber (IR), the executives pointed out, will free the United States completely from dependence on foreign sources of natural rubber in time of emergency. This development should also have a strong stabilizing effect on natural rubber prices and should allay doubts as to whether the supply of plantation rubber can keep pace with rapidly growing world demands.

Shell Chemical is manufacturing the new rubber under the trade name, Shell Isoprene Rubber, by part-time utilization of commercial equipment located at various Shell Chemical and Shell Oil Co. installations in the Los Angeles area. Shell scientists have developed a new chain of production processes which enables the company to produce synthetic IR at the 30¢-a-pound price, approximately equivalent to that for the better grades of natural rubber.

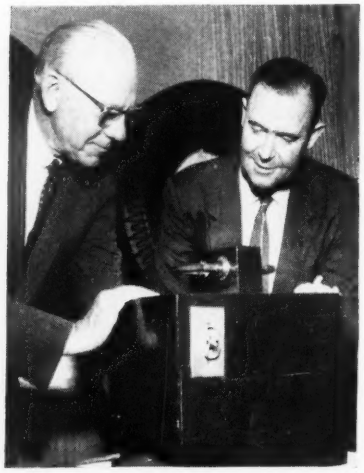
For the present the output of Shell Isoprene Rubber will be maintained at a rate averaging five tons a day in order to furnish a supply for U. S. Rubber's current usage and for other customer evaluations. As installation of various additions to the plant progresses during the year, the effective capacity is expected to increase to 15,000 to 20,000 tons annually.

Although U. S. Rubber is taking most of Shell Chemical's production of the new rubber at this time, Shell will make the rubber available to others on demand and depending on its availability. Mr. McCurdy said in New York that his company had not decided whether to license others to produce Shell's Isoprene Rubber or go it alone.

U.S. Rubber Synthetic IR Tires

Initially, Shell Isoprene Rubber is being used to make U. S. Royal Fleetway truck tires, size 7.50-20 at the L. A. plant of U. S. Rubber. This size tire contains 17.8 pounds of natural rubber, now replaced by the Shell Isoprene Rubber, and 8.1 pounds of styrene-butadiene rubber (SBR) with which the synthetic polyisoprene is entirely compatible. The company will expand production to additional truck tire sizes, off-the-road tires, aircraft tires, white sidewall passenger tires, and other products now requiring natural rubber as the supply of the new synthetic IR increases.

The price of the truck tires made with the new Shell IR will be the same as those made with natural rubber (NR). The wear will be about the same, it was said. Shell IR has been



J. W. McGovern, U. S. Rubber president, *(left)*, and R. C. McCurdy, Shell Chemical president, observe heat build-up of Shell IR vs. SBR

thoroughly tested in the laboratory and on the road where truck tires made with it have proved equal and in some cases superior to those made with NR.

The use of Shell IR in the tire making process will not require any changes except that the new rubber does not require as much plasticating; this is an advantage over the use of NR. An additional advantage is that the synthetic IR can be made to have more uniform quality than NR, which latter, being a natural product, has a greater variability in physical and chemical properties, color, and degree of contamination with dirt.

Technologists at U. S. Rubber's tire development laboratory in Detroit, Mich., have developed new compounding techniques and processing methods for this IR which provide for the proper curing times and adhesion required for normal tire building operations.

At the press conference in New York, G. R. Cuthbertson, vice presi-

dent and general manager of U. S. Rubber's tire division, and Arthur W. Bull, director of tire research and development for the company, were on hand to help explain the use of Shell IR in tires. Dr. Bull demonstrated the greater resilience (bounce) of the Shell IR and its lower heat build-up on flexing in comparison with SBR. This lower heat build-up was further demonstrated on a high-speed flexing machine (see preceding page).

Dr. Cuthbertson explained that U. S. Rubber's needs for IR can be met by an annual production of 15,000 to 20,000 tons. Total annual usage of natural rubber by U. S. Rubber amounts to 62,000 to 64,000 long tons.

Other products for which Shell IR might be used are waterproof footwear and rubber sundries in light colors, and mechanical rubber products exposed to flexing and twisting operations in service and where low heat build-up is important.

General Comments

In New York and Los Angeles, U. S. Rubber and Shell Chemical executives cautioned against undue concern as to the impact of this development on the production of natural rubber. Actually, they said, if the commercial availability of synthetic IR has the effect of reducing some of the unpredictable fluctuations in the rubber market, as is expected, then rubber goods producers can lay plans for its use with more confidence, thus broadening the market for both the natural rubber grower and synthetic rubber producer.

In New York, Mr. McGovern said U. S. Rubber expects to continue its operation and development of its natural rubber plantations in Malaya and Sumatra and will continue its program of replanting about 4% of its rubber trees a year in order to increase their yield.

Tyrex Claims 22-24% More Tread Mileage Than for Nylon Tires

William Dalton, president of Tyrex, Inc., New York, N. Y., a non-profit organization charged with enforcing standards for production of Tyrex viscose cord, has released the results of certain tire testing done to compare both passenger and truck tires made with Tyrex with those made with nylon and rayon cord. Tyrex, Inc., represents the following manufacturers of the cord: American Enka Corp.; American Viscose Corp.; Beaunit Mills Inc.; Courtaulds (Canada) Ltd.; and Industrial Rayon Corp. A passenger-car tire tread mileage for Tyrex cord 24% greater than that for nylon cord was reported in high-speed tests. Truck tires with Tyrex cord were reported to have delivered 21.7% more mileage than those made with nylon cord.

Passenger-Car Tire Tests

The first series of tests were run by Nevada Auto Testing Center in the vicinity of Winnemucca and Dayton, Nev., with passenger-car tires of equal construction, size, and strength, each made with nylon, rayon, or Tyrex viscose cord. Weights and inflation pressures were carefully equalized to insure thoroughly impartial testing, it was said.

Tests were conducted over 50 miles of abrasive black-top; test cars were standard vehicles of comparable size, weight, suspension, with engines modified for high-speed running. A grand total of 33,000 actual road miles was run in the tests.

At the start of each test run the cars were run 50 miles at 70 mph., 50 miles at 85 mph., and 50 miles at 100 mph., in order to break in and warm up the tires, after which the test course was covered at speeds from 110 to 128 mph., with 700 to 800 high-speed miles being covered each day.

The results of these tests, as summarized by Mr. Dalton, indicated 24% greater tread mileage for tires made with Tyrex cord over those made with nylon cord, one-third the growth shown by the nylon cord tires, and negligible groove cracking compared with considerable cracking of the tires made with nylon cord.

Tests were also made on secondary roads in the vicinity of Dayton, Nev., to evaluate the relative impact resistance of four-ply passenger-car tires made with different carcass materials. Tires used were of equal construction and strength standards.

All tires were given an initial break in of 500 miles, and each day the cars started with 120 miles of highway driving before beginning the test over unpaved roads. At speeds ranging from 10 to 45 mph., 100% load, and recommended tire pressures the first day and with the loads increased 10% and the tire pressures adjusted as per standard recommendations to maintain constant deflection, the tires were driven over rock out-croppings presenting severe impacts.

The first impact failure occured at 30% overload, and this level was maintained throughout the balance of the test. Tests were terminated when either 5,000 miles had been covered, or when five tires of a particular group had failed because of impact. Since there was a marked difference in the performance of identical tires on front and rear wheels, with most of the failures occurring on rear wheels, only statistics on rear wheels were reported.

In terms of impact breaks per 10,000 tire miles, one set of Tyrex cord tires gave five and another set three breaks; rayon cord tires gave 13 breaks; and nylon cord tires gave 15.

Truck Tire Tests

Truck tires made with Tyrex viscose cord were compared with tires of premium nylon construction in tests in South Texas, with ambient temperatures ranging from 69 to 101° F., and road surface temperatures ranging from 112 to 139° F. The tests were conducted by an independent testing organization, South Texas Tire Test Fleet, Inc.

Tires were run on tractor-trailer units with single-axle drive and on dual-axle trailers. A single tire was used in each position instead of dual mounts. Tires were placed on drive wheels and trailer wheels, making a total of six test tires per vehicle. Rotation was from position to position on the same vehicle after each test run of 850 miles. After each tire had run on every position, the rotation was made from one vehicle to another, thus each tire saw service in every position on each of the vehicles used in the test, with the rotation pattern being repeated throughout the test. The trailers were loaded with gravel in compartmented truck beds so that distribution of weight could be controlled.

For the first 10,000 miles the loads were 120% of The Tire & Rim Association recommendations. Thereafter, loads were increased 10% every 5,000 miles, with the last 10,000 miles being run with 150% loads. Tire pressures were 65 psi., cold. Speeds were maintained at 50 mph.

Mr. Dalton said that tread wear ranged from 72.5 miles per each 0.001-inch tread wear for nylon cord tires to 88.3 miles per each 0.001-inch for Tyrex cord tires, or 88,300 miles per inch of tread wear for Tyrex cord tires, against 72,500 miles for nylon cord tires.

Cross-sectional growth for nylon cord tires was 3.17%, against 2.12% in tires made with Tyrex cord.

It was emphasized that truck tires made with Tyrex viscose tires delivered greater original tread mileage, showed fewer failures, and, as a result, would incur less "down-time," all of important financial interest to truck owners and operators. The overall diameter growth ranged from 2.77% for nylon to 1.41% for Tyrex cord.

Committee D-11 Assigns Two New SBR Numbers

Committee D-11 on Rubber and Rubber-Like Materials of the American Society for Testing Materials through Subcommittee 13 on Synthetic Elastomers of D-11 has assigned numbers to new styrene-butadiene elastomers, SBR 1508, requested by Goodyear; and SBR 1603, requested by Phillips.

DESCRIPTION OF TYPES OF STYRENE-BUTADIENE (SBR) ELASTOMERS-ASSIGNMENT OF NEW CODE NUMBERS—ASTM D-11 1419-56T

Number as assigned	1508	1603
Date assigned	2/15/59	2/24/59
Requested by	Goodyear Tire & Rubber Co.	Phillips Petroleum Co.
Distinctive feature	normal finishing rather than special finishing	non-staining-cold rubber-EPC masterbatch
Close previous number, if any	1503	6611
Type	1508	1603
Nominal temp., °F.	43	43
Activator	FRA	FRA
Shortstop	ND	ND
Catalyst	OHP	OHP
Antioxidant	NST	NST
Emulsifier	FA	FA
Nominal bound styrene, %	23.5	23.5
Conversion, %	60	60
Mooney viscosity, ML 1—4 (212° F.)—polymer	52	—
Compound	—	58
Carbon black type	—	EPC
%	—	33.4
Finishing	normal	normal
Coagulation	SA	GA

Note: Abbreviations and symbols are defined as follows:
FRA = free radical type, i.e., iron-pyrophosphate, peroxamine sulfoxylate.
ND = non-discoloring.
OHP = organic hydroperoxide.
NST = non-staining.
FA = fatty acid.
SA = salt-acid.
GA = glue-acid.
EPC = easy processing channel.

Honors Dayton Rubber

Clowes M. Christie, president of Dayton Rubber Co., Dayton, O., was recently principal speaker at a Newcomen Society of North America dinner honoring the rubber firm for its pioneering research. He traced the company's history of firsts including the development of the world's first synthetic rubber tire introduced in 1934.

Guest of honor at the dinner was A. L. Freedlander, chairman of the board of Dayton Rubber. He was presented a bound volume containing copies of 103 patents he had received covering rubber developments.

Some other developments of the company include numerous firsts in passenger and truck tire developments including the first low-pressure tire, it was said. The company also pioneered in the development of the raw-edge V-belt, first used as an automotive fan belt and later in all phases of power transmission.

Firestone Searches 15 Years To Complete Its 139 Volumes of "India Rubber World"

The Firestone Tire & Rubber Co., according to W. D. Overman, manager of the Firestone library and archives at its home office in Akron, O., has made "the most important addition to our collection in recent years" with 46 leather-bound volumes of "India Rubber World" from 1889 to 1934.

These volumes, now out of print, were presented to Leonard K. Firestone, president of the Firestone Tire & Rubber Co. of California, by L. C. "Slim" Barnard, automotive editor for the *Los Angeles Examiner*. Barnard's late uncle, Henry C. Pearson, was the founder, editor, and publisher of "India Rubber World" from its beginning in 1889.

"India Rubber World" was purchased by Edward Lyman Bill, Inc., the predecessor of Bill Brothers Publishing Corp., its present owner, in August, 1926. Mr. Pearson continued as editor for some time thereafter. In 1954 the publication dropped "India" from its title and became RUBBER WORLD.

Dr. Overman said Firestone had searched for the past 15 years for the missing volumes to complete its set and that the books are now available to others in the rubber industry for study and reference. (Another complete set is available at the offices of RUBBER WORLD in New York for such purposes also. EDITOR.)

The Firestone announcement continued by explaining that "India Rubber World, first published in 1889, gives an accurate month-by-month report of the activity of the rubber industry as it developed from a small business into a multi-billion dollar industry. It is considered the 'bible' of the industry and includes news of technical progress, new products as well as personnel changes as they take place."

L. C. Barnard, automotive editor, *Los Angeles Examiner*, presents 46 volumes of "India Rubber World" to Leonard K. Firestone, president, Firestone Tire & Rubber Co. of California

E. H. Gibbs Orris H. Johnson Ralph T. LaPorte

Seiberling Ups Three

Seiberling Rubber Co., Akron, O., is expanding its tire research and development program to bring out entirely new types of tires and related products. It has added a special tire research group to work on new products and also has enlarged its tire development department, according to E. A. Hensal, vice president in charge of production.

In the move E. H. Gibbs has been named manager of tire development and research. He will be responsible for all activities of the research and development program. Ralph T. LaPorte, who had been chief chemist, is now manager of tire research and compounding; while Orris H. Johnson, manager of tire design, becomes manager of tire engineering.

Gibbs was manager of Seiberling's development department since 1944. Previously he had been manager of tire design and manager of foreign plant service. LaPorte became chief chemist at Seiberling in 1936, having joined the company in 1924. He also served as production manager in the company's mechanical goods department. Johnson was manager of tire design since 1956. He started with the company in 1954 as assistant manager of that department.

Two New SP Rubbers

The Rubber Research Institute, Kuala Lumpur, Malaya, has developed two new types of superior processing rubber which are expected to increase the usage of S. P. rubber during 1959, according to the National Rubber Bureau, Washington, D.C. The first type is an S. P. Brown Crepe which will answer the requirements of manufacturers who like the superior processing advantages of S. P. rubber, but do not want to use the premium grade rubbers in their cheaper lines. Heretofore S. P. rubber was available in only the higher grades. The second type is S. P. 90, a concentrate that adds the advantages of S. P. to any rubber.

In this latter case, the manufacturer mixes S. P. 90 with any grade, or mixtures of grades of rubber, natural or synthetic, according to RRI. The result is his own particular mix—but with all the extruding and calendering of S. P.

In the manufacture of extruded goods, S. P. provides faster production, smoother surface, and lower die swell. In calendering, it provides better surface, gages closer to settings, and allows wider temperature ranges. It is particularly effective and easy to work with in precision work where the tolerances are narrow.

It is expected that the new S. P. Brown Crepe and S. P. 90 will be available during the second half of 1959. They will contribute to growing sales this year, but their full effect probably will not make itself felt until 1960. The RRI has announced that production facilities have been amplified to the point that Malaya will be able to meet increased demands for S. P. rubbers.

Witco-Emulsol Merger

Witco Chemical Co., Inc., New York, N. Y., has announced the merger of Emulsol Chemical Corp., Chicago, Ill., a Witco subsidiary, with its organic chemicals division. The move will widen distribution of Emulsol products through the use of Witco's extensive sales force. The Emulsol sales staff will be absorbed into the Witco organization. A. O. Raven has been appointed products manager of the Emulsol products line.

The merger will also result in a 50% expansion of Emulsol research facilities. The Emulsol laboratories are being consolidated with Witco's research and development laboratories at 6200 W. 51st St., Chicago. Construction is under way to accommodate the additional equipment and staff. The Emulsol plant remains at its present location, 1914 S. Kilbourn Ave.

Emulsol Chemical Corp., founded in 1926, is a leading producer of emulsifying agents and other surface-active chemicals. Its products are widely used in the manufacture and processing of a wide range of items including industrial and mining chemicals. It is expected that the Emulsol line will show marked growth in both diversity and total volume as a result of the merger.

Tubeless's Tenth Year

Officials of The B. F. Goodrich Co., Akron, O., originator of the tubeless tire, met with nearly 100 business, financial and civic leaders in Miami, Fla., recently to celebrate the tenth anniversary of the tubeless tire. E. F. Tomlinson, president of the company's tire division, proclaimed the tubeless tire the greatest achievement in tire development in more than 50 years.

The occasion was held exactly ten years from the date when the BFB puncture-sealant tubeless tire, as it was then known, made its bow into the Florida market. On hand was the BFG project engineer who brought the tubeless tire into being—Frank Herzegh. Herzegh showed films of his demonstration of the tubeless tire, taken when the tire was introduced in Miami in 1949.

Tomlinson predicted that by the end of 1959 the country's motorists will be riding on 175 million tubeless tires, a sizable increase over the 1958 figure of 157 million. He also said that BFG today markets 914 different types and sizes of tubeless tires, adding that other manufacturers approach this total.

To Study Solid Fuels

A new unit of scientists has been organized by Esso Research & Engineering Co., Linden, N. J., to conduct advanced research on super rocket fuels under a contract awarded by Army Ordnance. Esso was selected last fall by the Defense Department's Advanced Research Projects Agency (ARPA) for this key role as part of a broad new program to perfect superior solid fuels. The $1,264,000 one-year contract is on a cost, non-profit basis.

Esso Research has announced the appointment of John P. Longwell to direct the project. He has contributed to the development of the Talos missile under a Navy contract. John F. Kolfenbach has been named assistant head of the project.

The company's experiments under this contract involve both petroleum-based and non-petroleum materials.

New AviSun Firm To Produce Polypropylene

American Viscose Corp. and Sun Oil Co. have established an equally owned affiliate, AviSun Corp., Philadelphia, Pa., that is scheduled to be the nation's second and largest commercial supplier of polypropylene by mid-summer.

Sun scientists have developed a process for the manufacture of polypropylene resins, and American Viscose researchers have developed new processes for the manufacture of polypropylene film and fibers. AviSun will be an integrated company for the manufacture, processing, and sale of resins, film, fibers, elastomers, surface coatings, and adhesives using olefin polymers or copolymers with other substances.

Commercial quantities of polypropylene resin are expected to be available by mid-summer from leased facilities of the Port Reading, N. J., linear polyethylene plant of Koppers Co., Inc. One line of the plant is now being modified for polypropylene production using a process developed in the research laboratories of Sun Oil. Koppers will operate the process under the technical direction of AviSun. The capacity of the converted plant is estimated to be 20 million pounds a year.

Chalmer G. Kirkbride, executive director of research and engineering for Sun, has been elected president of AviSun. William H. Brown, vice president and treasurer of Viscose, was elected treasurer and assistant secretary of AviSun, and Joseph T. Wilson Jr., assistant secretary and assistant treasurer for Sun, has been elected secretary and assistant treasurer of AviSun.

Other directors of AviSun in addition to the officers named above are: Frank H. Reichel, Harry L. Dalton, Gerald S. Tompkins and Herschel H. Cudd, from Viscose; and Robert G. Dunlop, Clarence H. Thayer, and Willard W. Wright, from Sun.

Until commercial production of polypropylene is achieved at the Port Reading plant, Sun is providing pilot-plant quantities of new polymers and copolymers under contract to AviSun. Initially, the manufacture of film and fiber is being handled by American Viscose under contract to AviSun. Concentrated olefins for the commercial production of polypropylene will be supplied as far as possible by Sun to AviSun.

Seiberling To Expand Its Plastics Division

Seiberling Rubber Co., Akron, O., announced at a March press conference that its plastics division, which began operations as an entirely new venture in 1955, had outgrown its Newcomerstown, O., plant and would be expanded. Construction has already begun on a new plant addition that will provide 20,000 square feet of new production space, laboratories, and office area. It is scheduled for completion this spring, according to J. P. Seiberling, president of the company.

J. P. Seiberling *(left)* and H. M. Zimmerman examine luggage and acid-resistant tanks made from Seilon, Seiberling's plastic

With the added space and equipment to be installed, the plant's capacity will be greatly increased. All current operations are on 24 hour schedules, and the plant has worked many week-ends in recent months. The division will expand its present lines of press laminated plastic sheets under the trade mark Seilon, and add new products. The division has set the goal of doubling its sales within the next three years.

Seiberling entered the plastics field as a producer of rigid polyvinylchloride sheets, press-laminated in building material sizes, and has since added a variety of other plastic products, supplied to plastic converters. Seilon descriptions and applications include: CR—Type I PVC corrosion; HI—Type II PVC corrosion; LC—copolymer vinyl sheets for printing, laminating, and vacuum forming; VHI—highest impact copolymer vinyl sheets for printing, laminating, and vacuum forming; S-1—high impact polystyrene; S-2—super-high impact styrene; S-12—extra-high impact polystyrene with properties between S-1 and S-2; S-3—tough thermoplastic ABS polymer for vacuum forming; ETH—extruded polyethylene for vacuum forming and for fabrication of corrosion-resisting equipment; ETH-R—extruded rigid high-density polyethlene; and PRO—extruded polypropylene.

Harry Zimmerman is general manager of the plastics division, Frank Sherry, plant manager; and Carl Figenscher, sales manager. About 75 are employed at the compact, modern plant, situated on a 12-acre tract in Newcomerstown.

The division has specialized in custom-made plastics to meet special needs of manufacturers. Materials are used for ductwork and other chemical handling equipment, for advertising signs, luggage, athletic equipment, credit cards, plastic bindings, and many other articles.

Seiberling was the first to produce extruded sheets of polypropylene for commercial applications, developing the material and producing it for sale within four months after the new low-density plastic was first introduced.

Vinyl-to-Steel Cement Made in New BFG Plant

A new metal coating system that marks a major advance in bonding vinyl plastic to steel was recently announced by B. F. Goodrich Industrial Products Co., Akron, O., at the formal opening of its new modern adhesives plant in Akron. It was reported that sheet steel bonded with the new A-978-B cement can be stretched 35% without weakening the bond or damaging the vinyl coating. The adhesives plant has previously been announced.[1]

The new plant will produce everything in adhesives from stationery cement for office use to tough adhesives for putting airplanes together and bonding automotive brake linings. These structural adhesives like BFG's Plastilock are reported to be stronger than the metals they bond.

Tests used to evaluate A-978-B included boiling the bond in water for 30 minutes, exposure to 200° F. for seven days and humid storage at 160° F. for 1,000 hours. The tests proved that the A-978-B bond remains as strong after stretching as before, according to the company.

The new material permits sheet steel to be vinyl coated, embossed, and then deep-drawn (forming deep cup shapes by stretching flat steel sheet) without ruining the adhesion. This process is far simpler, faster, and more economical than drawing the metal and finishing it later as had been the method heretofore.

Chief markets for vinyl coated steel include the automotive industry—for door panels, dashboards, kick plates, and trim; the construction industry—for wall panels; the appliance industry—for cabinets for radio and TV, refrigerators, washers, and dryers.

The company's adhesive products division will market the new material to basic steel producers or converters. Industrial users may purchase the adhesive either by itself or together with a BFG plastisol especially developed for use with a A-978-B in a completely packaged metal coating system.

[1]Rubber World, Dec., 1958, p. 442.

General Mills Holds Fatty Nitrogen Seminar

Qualities and potential uses of a versatile family of fatty nitrogen chemicals was the topic of discussion at a seminar held in New York, N. Y., on January 27 by General Mills' chemical division. The seminar was also held during the same week in Philadelphia, Chicago, and Los Angeles. The audience in attendance was largely from the petroleum, textile, rubber, mining, and chemical industries. Hosts were the top men of General Mills' chemical division.

The company's fatty nitrogen chemicals are already in use as petroleum product additives, mold release agents for hard rubber goods, textile conditioners, corrosion inhibitors, bactericides, and chemical intermediates.

The company's primary fatty amines are currently being used by the rubber industry as mold release agents in hard rubber molding, specifically battery boxes. The following products apply here: Alamine 7D, distilled primary stearyl amine; Alamine H26, primary hydrogenated tallow amine; and Alamine 46, crude mixed amines. Alamine 4, primary lauryl amine, and Alamine 26, primary tallow amine, are used in rubber reclaiming.

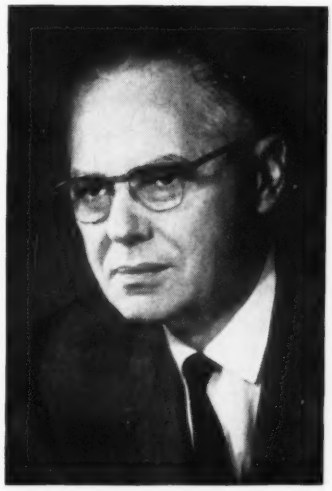
The monofatty trimethyl ammonium chlorides, Aliquats 4 and 26, lauryl trimethyl and tallow trimethyl ammonium chlorides, respectively, are used as gel sensitizers in foam rubber applications. Other fatty nitrogen chemicals are being evaluated as softeners, tackifiers, and emulsifiers for synthetic rubbers.

A technical bulletin which gives fatty nitrogen product specifications and reaction summary is available from the company. Another technical bulletin, 12-A, gives fatty nitrogen compound specifications, suggested reactions, and uses. Both are available from the chemical division's headquarters in Kankakee, Ill.

Raybestos-Manhattan Makes Major Changes

Raybestos-Manhattan, Inc., has announced that John H. Matthews, executive vice president, retired from full general management responsibilities of its Manhattan Rubber Division, Passaic, N. J. He will continue as a director of the firm and as a consultant. His service during the last 45 years has been instrumental in bringing Manhattan to its present size and high degree of efficiency. He is also director of the American Synthetic Rubber Co., Louisville, Ky., The Rubber Manufacturers Association, Inc., and the Manhattan Securities Co.

Other personnel changes follow.



J. N. Kuzmick

Joseph N. Kuzmick became divisional manager of Manhattan Rubber with Clarence P. Schneider as his assistant. Kuzmick, who joined Manhattan in 1919, previously was coordinator of corporation research and development activities. He has been active in the development of abrasive and diamond wheels, synthetic resins, plastic products, bowling balls, brake linings, and sintered metal friction products. As coordinator, he became familiar with all corporation products and future development planning.

Schneider, who started with Manhattan in 1929, had been assistant manager of the friction material department at Passaic. Most recently he was general manager of the Wabash division at Crawfordsville, Ind., to which he had been appointed factory manager when this plant was built in 1951. He will move to the Passaic area, but will continue as general manager of the Wabash division.

Robert J. Gorecki and Wilder E. Perkins have been made manufacturing general managers in charge of production departments at Manhattan. Gorecki supervises and directs activities of departments manufacturing molded products, flat belts, packings, friction materials, abrasive and diamond wheels, and bowling balls. Perkins directs the departments manufacturing V-belts, hose, platens, rolls, tanks, and blankets. Both started with Manhattan in 1926.

Dayton Rubber Buys Two Western Firms

The Dayton Rubber Co., Dayton, O., has acquired complete ownership of two West Coast aircraft equipment manufacturers—Hardman Tool & Engineering Co., Los Angeles, and Aircraft Standards, Inc., Santa Monica, both in California. The two firms have reported a combined volume in excess of $6 million in 1958 and hold more than $5 million in back orders for aircraft products, according to Dayton Rubber.

Hardman Tool is reported to be the nation's largest manufacturer of aircraft seats and is a supplier to more than 70 world airlines. It also manufactures ejection seats, shoulder harness inertia reels, fuel tanks, and baggage containers. Aircraft Standards manufactures highly engineered tools, dies, and fixtures for the aircraft and missile industries.

Acquisition of these two subsidiaries ties in with Dayton Rubber's stepped-up program to become a major supplier to the aircraft and missile industries centered in Southern California. Earlier this year, Dayton Rubber established the Strato-Safety Equipment Co., at Torrance, Calif., which will produce oxygen hose and face masks and other allied products for high-altitude military and commercial flight.

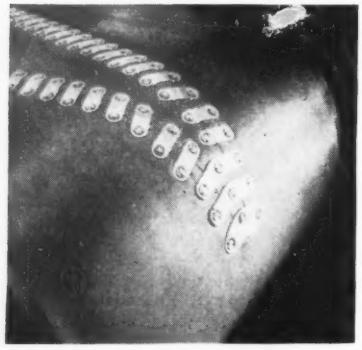
Named as new officers of the two new subsidiaries were: C. M. Christie, president; T. P. Dougan, vice president; and Victor Koontz, assistant secretary and treasurer. There will be no other changes in the management personnel of these subsidiaries.

New P. E. Albert & Son Machinery Company

P. E. Albert & Son Machinery Co., dealers in rebuilt and guaranteed used machinery for the rubber and plastics industries, is now operating in Trenton, N. J. Phil Albert, who has been associated with the industry for the past 28 years, recently purchased from L. Albert & Son, division of Bellanca Corp., its equipment and inventory, including spare parts located at Trenton. Headquarters and operations are maintained at 21 Nottingham Way, Trenton, N. J. Associated with Mr. Albert in this new organization is the same staff which has worked with the Albert organization in the Trenton territory for many years.

P. E. Albert in 1931 joined L. L. Albert & Son at the Akron, O., plant, starting in the machine shop and engineering department. Later he was transferred to the Trenton plant, having had charge of the operations of the L. Albert & Son firm at its Stoughton, Mass., and Los Angeles, Calif., plants, as well as at Trenton for many years.

The Trenton plant has complete facilities for doing all kinds of rebuilding work, and a staff of well-trained mechanics and engineers for supervising not only the rebuilding, but also the installation of all kinds of equipment used in the rubber and plastics industries.



View of new Wedlok splice

New Wedlok Belt Splice

A new patented method for splicing conveyor and elevator belts has been developed by the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. The new Wedlok splice, which eliminates costly field vulcanizing, is a high-tension mechanical fastener, rated equal to a conventional vulcanized splice, for operating tensions up to 700 pounds per inch of width on belts of five or more plies and thicknesses of ½-inch and more. Substantial costs savings are said to be realized by this method.

Two rows of No. 2 Flexco bolt and plate fasteners with Monel tops are installed along a V-shape splice-cut in assembling the Wedlock splice. Tip and tail fasteners at the extremities of the rows of fasteners assure a permanent seal under operating tensions. Field installation can be completed with tools necessary to make a conventional Flexco joint, eliminating costly vulcanizing equipment.

All special plates and complete instructions included in a special Wedlok splice kit and No. 2 Flexco fasteners with templates are available through authorized Ray-Man marketing channels. Purchase of kit licenses the user to make the Wedlok splice under the company's patent. A descriptive brochure, No. M 380, is available from the company.

Viton Used in New Hose

A new flexible hose which can be used for short periods at temperatures up to 600° F., lasts almost indefinitely at 350° F., and resists extremes of chemical attack, is now being marketed by the Thermoid Division, H. K. Porter Co., Inc., Philadelphia, Pa. This large-diameter hose is made with Du Pont's new fluoroelastomer, Viton, and high strength and resistance to abrasion are contributed by a jacket of Dacron polyester fiber.

The new hose can be used with jet fuels, highly aromatic mixtures, and petroleum-based lubricants at temperatures as high as 400° F. The design of the hose gives minimum burst strength of 600 psi., and it can be used with low-pressure steam, hot water, and condensing steam. For conducting hot air or other oxygen-containing systems, it has a use life in excess of 2,400 hours at 400° F.

The hose, it is said, resists penetration by tetraethyl lead compounds used in aviation and motor gasoline and has exceptional resistance to such solvents as carbon tetrachloride, benzene, toluene, and xylene, as well as to concentrated acids and bases. The hose is available in one- to four-inch inner diameter sizes, with or without couplings.

Offers Teflon Coating

Increased output in rubber processing and manufacture is attained by coating parts of rubber handling machines with a thin film of Teflon TFE resin, reports Cadillac Plastic & Chemical Co., Detroit, Mich., who is now offering the coating service. The film is not affected by solvents and other chemicals normally employed in the rubber industry and does not contaminate the materials with which it comes in contact, it is claimed.

Improved efficiency is obtained because the film prevents rubber from sticking to metal equipment and forms during fabrication without the need of lubricants. Cadillac Plastic reports successful applications including calender end plates, laminating platens, mandrels, agitator paddles, conveyor chutes and tubes, feeder troughs, molds and molding dies, ladles and other metal containers, rubber boot lasts, and packaging equipment.

The TFE film is applied by a special process that bonds it to the metal and is highly resistant to abrasion. The film is reported to be long lasting.

A. Holmberg Retires

Albert W. Holmberg, manager of commodity sales for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., recently retired after having completed 50 years of service in the rubber industry.

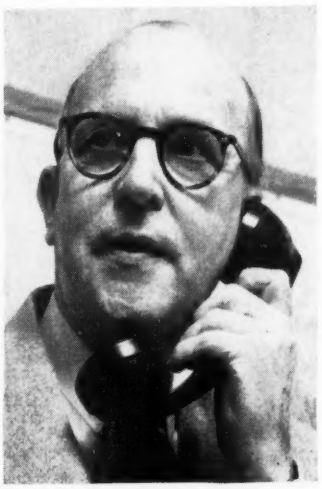
From Mr. Holmberg's viewpoint, the most important development in the rubber industry during this period was the growth of the latex and latex compound business. Naugatuck Chemical pioneered in this field, and Holmberg was a major factor in this pioneering effort. For more than 30 years he has worked in the field of latex and latex compounds, first in development and later in sales.

Mr. Holmberg's first job in the rubber industry was a laboratory assistant at the Rubber Regenerating Co. Four years later the firm became part of U. S. Rubber Co., and young Holmberg was transferred to the firm's general research and development laboratories, then in New York, N. Y. Late in 1919, after military service overseas, he joined the company's footwear laboratory in New Haven, Conn., where he ran rubber compounding and wear tests. He returned to the general laboratories in 1921, working with chlorinated rubber. In 1922 he began work on latex projects.

His first assignment in latex was the development of industrial applications for the liquid rubber. Some of his early assignments included dipped goods, can sealing, web fabrics, foam paper and fabric impregnation, and the spreading of such products as pile fabric and carpet backing. It was in this early period, while the search was being made to put this material to use, that the idea of compounding liquid rubber for specific uses was born.

In 1929, Mr. Holmberg was transferred to Naugatuck Chemical and the laboratory at the Connecticut plant. The company put up a plant there for latex dipping, one of the first such plants in the United States. Today, while out of the dipping business, Naugatuck is still very active in the latex compounding field. It currently has three plants—in Naugatuck, Gastonia, N. C., and Los Angeles, Calif. —producing compounds.

In 1943, Mr. Holmberg entered the sales field and in 1947 became sales manager of colloidal products for Naugatuck Chemical. Ten years later he was appointed manager of commodity sales, and in this post, until the time of his retirement, he supervised commodity managers for all of the Naugatuck Chemical products, which range from plastics to rubber chemicals.



Albert W. Holmberg

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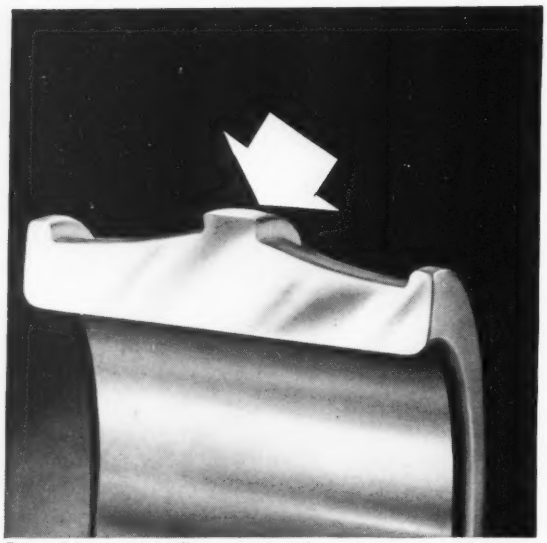
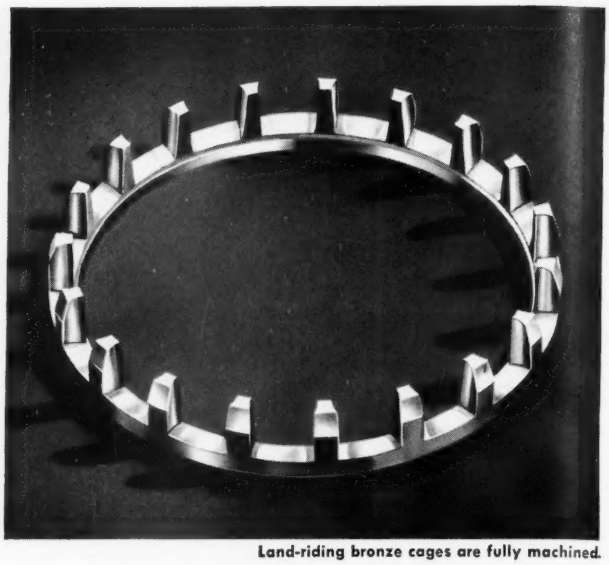
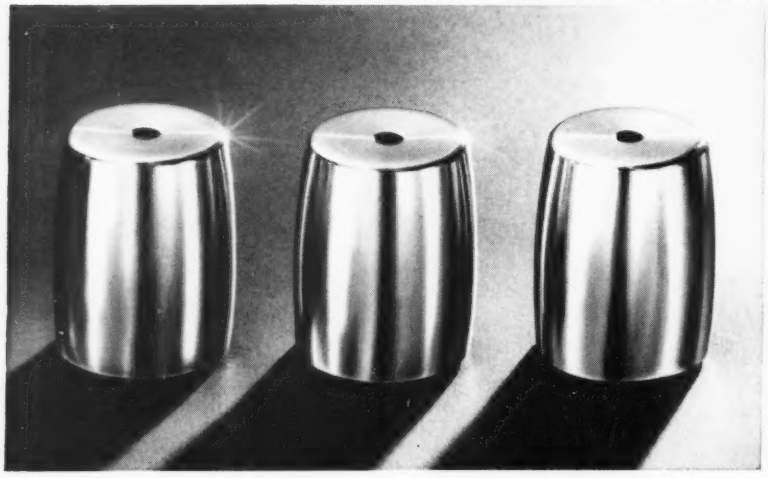


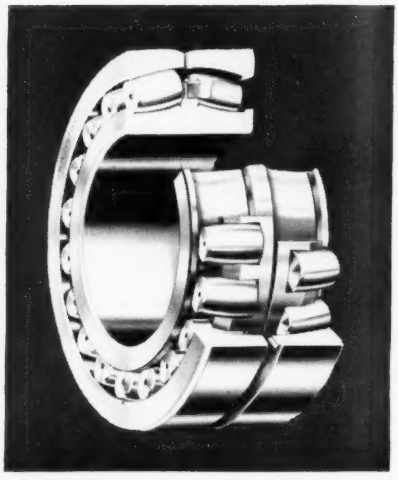
Center flange guides rollers to peak performance.



Land-riding bronze cages are fully machined.

Roller diameters are matched electronically within .0001".





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There's no substitute for the stabilizing effect of the integral center guide flange. Torrington's asymmetrical roller seeks this flange under load. Skewing and stress concentrations are eliminated. Every roller carries its share of the load, for roller diameters are matched electronically within .0001" for even load distribution.

Rollers are precisely spaced by fully machined land-riding bronze cages that withstand even the high stresses of eccentric service. Two independent cages, one for each row, prevent roller drag and side stresses under thrust loads. Size-stabilized races prevent "growth" or change in dimension in service.

These features mean a cooler-running, longer-lasting bearing. When you buy bearings, look into *every* detail, and you'll choose Torrington. **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

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- Integral guide flange for roller stability
- Asymmetrical rollers seek flange for positive guidance
- Electronically matched rollers
- Size-stabilized races
- Fully machined land-riding bronze cages
- Controlled internal clearances
- Even load distribution
- Inherent self-alignment
- Long service life

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S. G. Byam

Du Pont's Byam Retires After Varied Career

Seward G. Byam, sales manager in charge of technical publications of the elastomer chemicals department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., and active in the rubber industry for more than 43 years, retired from the company on February 27.

Long active in the American Chemical Society's Division of Rubber Chemistry and its chairman for the 1952-53 term, Byam is widely known for his substantial contributions toward standardizing the rubber industry's technical language.

Mr. Byam joined Du Pont in 1919 as chief chemist at the Fairfield, Conn., plant. In 1922 he left to work as chief chemist at the Plymouth Rubber Co., and in 1923 became general superintendent there. He returned to Du Pont in 1925 as assistant plant manager at the Fairfield plant.

In 1932, Byam was transferred to the Wilmington office, became assistant sales manager for rubber chemicals in 1938, was appointed assistant manager of the rubber laboratory at Deepwater Point, N. J., in 1941, and was made associate laboratory director in January, 1943. He was named neoprene sales manager in September, 1943. During his 11 years in this post, neoprene consumption increased tenfold. In 1954 he assumed the position of sales manager in charge of technical publications.

He was born in Rome, N. Y. He received his Bachelor of Philosophy degree in chemistry from Brown University in 1916. Following graduation and prior to joining Du Pont, he has worked as a chemist for the United States Rubber Co. in Providence, R. I., and for the U. S. Government's Bureau of Aircraft Production, Pittsburgh, Pa.

Snell Announces New Rubber Chemical Check

The elastomer section of Foster D. Snell, Inc., New York, N. Y., has announced a new consulting service to the rubber industry and its compounders. The section plans to issue a monthly report describing the compounding and testing of promising new rubber chemicals in various elastomers. The reports, not duplications of suppliers' literature, are designed to give the compounder the chance to find unexplored and unsuspected uses in his particular product for new rubber chemicals.

The section proposes to supply a new product evaluation service based on objective laboratory compounding and testing. It will supply a series of 12 reports covering various new rubber chemicals such as resins, fillers, accelerators, etc., in five elastomers (natural, SBR, neoprene, nitrile, and butyl) for a yearly subscription of $350. Subscribers will have the opportunity of voting for materials in which they have special interests. The elastomer section anticipates that materials such as reinforcing resins and fillers, antioxidants and antiozonants, curatives and accelerators, softeners and plasticizers, and non-reinforcing fillers will be more or less equally represented. Visits at the firm's laboratories and discussions concerning the program will be welcomed.

A breakdown of the report will include five sections: (1) formulas, (2) rheological properties, (3) curing properties, (4) vulcanizate properties, and (5) discussion of results and recommendations. The company plans to close the current subscription list on April 30. Further information and schedules will be issued by the company shortly thereafter.

Robson Wants More Traction in Roads

J. J. Robson, director of tire engineering and development of The Firestone Tire & Rubber Co., recently appealed to a group of legislators and highway engineers to build more traction into roads and to find a way to retractionize smooth or slick highways. He spoke at the annual highway engineers conference at the University of Utah, Salt Lake City, in March, outlining what the tire has done for the highway and what highway engineers can do for the tire.

He suggested that they provide a traction surface that will last and find a treatment to retractionize smooth roads. There is a great variation in the skid resistance of different paving materials, he noted, and many pavements have inadequate traction qualities even when new. The real test of highway traction can be made when the roadway becomes wet.

A standard method of measuring traction is required to permit all authorities, worldwide, to design the best roads possible. Research is needed to determine the traction characteristics of the different types of road surfaces, Robson continued.

NEWS BRIEFS

THE FIRESTONE TIRE & RUBBER CO., Akron, O., has been awarded a $5,044,080 contract for the continued production of the Corporal guided missile by U. S. Army Ordnance. Firestone has been producing the surface-to-surface guided ballistic missile in its Los Angeles, Calif., plant since 1951. The Corporal, which is capable of carrying either a regular or nuclear warhead, is the only one of its kind in operational use by U. S. Armed Forces. The last contract, for $5,860,000 was awarded in December.

H. E. HUMPHREYS, JR., chairman of the board, United States Rubber Co., told the New York Society of Security Analysts in New York in March that U. S. Rubber expects record sales of $950 million and earnings of no less than $4.50 a common share in 1959. He revealed that the company is in the midst of a concentrated program to apply automation to the manufacture of tires which, when completed, will reduce the time required to process a passenger car tire from 48 to less than four hours.

U. S. RUBBER RECLAIMING CO.'S Thomas A. Johnson, a research chemist, has been granted United States patent No. 2,871,774 covering a new use for rubber. The invention, assigned to the Buffalo, N. Y., company, relates to a method of binding together rubber pellets with asphalt in order to produce a soft permanent surface for playgrounds, tennis courts, and similar areas. The product can withstand all weather conditions, according to the company.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO., a division of The B. F. Goodrich Co., Akron, O., has developed a flexible, slim hole rotary hose that will not kink or collapse in service, it is claimed. Called the Commander hose, it is furnished with an exclusive reattachable coupling that enables hose to be recoupled in the field simply and quickly. Reinforced with more than 10 miles of high tensile strength, heavy steel wire in every 50-foot length, Commander hose is designed especially for slim hole drilling and for use on portable drilling rigs, workover rigs, and geophysical rigs.

THE KENDALL CO.'S ANDREWS-ALDERFER DIVISION, Akron, O., has announced price increases averaging 10% on FABRIcushon foam fabric products used in the corset and brassiere industry. This announcement follows an earlier one of price increases on the firm's foam and fabric combinations used in the shoe industry and on its line of foam carpet cushioning. These first upward price changes on foam fabric products for nearly six years have been necessitated by continuous wage and material cost increases.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has expanded its racing tire line to cover all track conditions on the NASCAR circuit. Included are the Blue Streak Special for asphalt with tube, or the Captive Air-type Blue Streak Special with nylon and steel inner spare that allows a race-car driver to continue racing after tire failure. The All-Weather Raceway tire is designed for dirt tracks, and the All-Weather Speedway can be used on either dirt or asphalt surfaces. Goodyear also produces the Blue Streak "160" for high-speed performance tests, which has been speed-wheel tested at 200 miles per hour. It is an improved version of the Blue Streak Special racing tire, designed for long high-speed asphalt type tracks. Blue Streak Special tires are produced in 7.50/8.00-14, 8.50/9.00-14, 6.50/6.70-15, 7.10/7.60-15, and 8.00/8.20-15 sizes. The All-Weather Raceway and the All-Weather Speedway tire sizes are 7.10/7.60-15 and 8.00/8.20-15.

UNITED STATES TESTING CO., INC., Hoboken, N. J., has been awarded a half-million-dollar contract with the Quartermaster Corps of the U. S. Army, to test specification performance of military suppliers on a wide variety of purchased products. Materials included in the contract are chemicals, inks, insecticides, insulation materials, metals, enamels, paints and lacquers, paper and packaging materials, plastics, rope, cord and twine, rubber products, soap, textiles, wood and furniture, and many other products. The new contract became effective January 2 and is to continue for one year.

UNITED STATES RUBBER CO., New York, N. Y., has developed an electronic safety device that automatically shuts off a Banbury mixer when its internal temperature exceeds a safe limit. The new device, called a Banbury temperature limiter, was developed by U. S. Rubber and Thermo-Electric Co., Inc., Saddle Brook, N. J. Already more than 70 of the devices have been installed in various U. S. Rubber plants. The device is a Banbury monitoring system which is automatic and takes away from the operator the decision as to whether danger of fire or explosion exists.

RO-SEARCH, INC., Waynesville, N. C., has announced that two European, one North American, one Asiatic, and one Oceanic firm will soon begin production on its Process 82 pressure molded vulcanized footwear. The installation of equipment at Hamgaper, Ltd., in Israel is now in its final stages, and production of workshoes, men's heavy walking shoes, and army combat boots is expected to begin shortly. The firm O'Brien, Ltd., in New Zealand has completed its installation, and George Milner, one of Ro-Search's senior technicians, has arrived in New Zealand to supervise the training program. The vulcanizing machines and molds for Plastica, in Denmark, and Landa Shoe, in Belgium, and for Kaufman Rubber Co., Ltd., in Canada, will soon be ready for shipment.

POLYMER CORP., LTD., Sarnia, Ont., Canada, has awarded building contracts to Sarnia firms for construction of a service building at the site of its No. 4 warehouse and a new synthetic rubber pilot plant. Curran & Horridge Construction Co., Ltd., will build the pilot plant, to be known as No. 3 Pilot Plant, which is a further step necessary to accommodate the expanding and accelerating program on new synthetic rubbers. Maaten Construction Co., Ltd., will construct a new warehouse service building on a new site on Churchill Road. The combined program will cost about $552,000, including the furnishing and equipping costs.

HOOKER CHEMICAL CORP.'S DUREZ PLASTICS DIVISION, has inaugurated a new and progressive type of shipping service to customers from its North Tonawanda, N. Y., facilities. Bulk shipments of large-volume liquid phenolics in 3,400-gallon lots are now being made with safety and efficiency in a unique rubberized container, the "Sealdtank," developed by United States Rubber Co. at its Providence, R. I., plant, to whom the first Durez shipment was consigned.

THE FIRESTONE TIRE & RUBBER CO., Akron, O., has been awarded the first production contract for inflatable dunnage used to protect U. S. Army freight during shipment. The $255,800 contract, received from the U. S. Army Quartermaster Corps, Columbus, O., General Depot, was for 5,780 of the rubber-coated nylon fabric bags called Pneumatic Cargo Dunnage Mattresses. The deflated mattresses are placed between units of cargo and then inflated. The rectangular-shaped mattresses support and prop up the cargo, protecting it from motion and vibration damage during transit.

THIOKOL CHEMICAL CORP.'S history and dynamic development is presented in a condensed story in the March, 1959 issue of *The Reader's Digest*. This feature, entitled "The Gunk That's Out of This World," reveals how Joseph C. Patrick discovered and named Thiokol polysulfide rubber, how the Thiokol company was formed, and how the company grew. It also tells how the synthetic material has found increasing use as a binder in solid rocket propellants. The full story appears in the March, 1959, issue of *True, The Man's Magazine*.

SEIBERLING RUBBER CO.'S. rubber workers in Akron, O., boast a giant photo of movie actress Debbie Reynolds as part of some unique factory decorations. The picture is a copy of one she sent tire builder Henry Neidert, who unknowingly built her a set of tires. Tires were given to Debbie after she helped host wives of Seiberling dealers at an M-G-M movie set. When Miss Reynolds sent Neidert an autographed picture, Seiberling Production Manager E. P. Schrank gave it to Neidert along with a four-foot enlargement which now hangs prominently in the factory.

AMERICAN FOAM RUBBER CORP., New York, N. Y., has leased a modern, one-story building in Penndel, Pa., from the Enterprise Wallpaper Co., Inc., and will occupy the 50,000-square-foot masonry structure for a term of years. American Foam Rubber will utilize the building for expanding production and warehouse facilities of its product, Mirafoam.

NATIONAL - STANDARD CO., Niles, Mich., has announced that a 45,200-square-foot addition scheduled for completion July 1 will provide 432,200 total square feet of manufacturing space at its Niles plant. The expansion will provide increased capacity for producing Copperply, the firm's recently introduced copper-plated steel wire, and other items, and space for realinement of present operations to increase manufacturing efficiency.

THE B. F. GOODRICH CO., Akron, O., reported that it experienced its highest sales year in replacement tires, and good sales levels were attained in footwear, aviation products, and certain other lines, in its annual report for the year ended December 31, 1958. Major cost reductions effected in late 1957 and throughout 1958 aided substantially in holding the decline in earnings to 9.9%, it was said. The outlook for 1959 was considered to be encouraging.

GOODYEAR TIRE & RUBBER CO., Akron, O., in its annual financial report, pointed out that overseas tire demand is growing nearly twice as fast as in the United States, and that foreign auto production in 1958 almost equalled American car production. Goodyear's 1958 net earnings were equal to $6.08 per share, compared with $5.99 per share in 1957.

L. SONNEBORN SONS, INC., New York, N. Y., petroleum refiner, at its Franklin, Pa., refinery is intensifying its research directed toward supplying specialized petroleum solvents for industry. Solvent research is designed to provide industry with custom-made solvents to meet a variety of requirements. Companies in the plastics, rubber, dry cleaning, chemical processing, and other industries are invited to submit their solvent problems to: Department of Industrial Research, L. Sonneborn Sons, Inc., 300 Fourth Ave., New York 10, N. Y.

UNITED STATES RUBBER CO., has established a tire retreading center at Fortville, Ind., to test new retreading techniques, equipment, and materials under actual production conditions. The facility will be operated as a model retread shop where automation, time studies, shop layouts, new processes, equipment, tread rubber, and repair products can be evaluated continuously. It will maintain close liaison with the tread rubber development department at U. S. Rubber's Indianapolis plant, 27 miles away. The facility will also serve as a training center for customer personnel and as a wholesale retread service outlet for dealers and oil companies in the adjacent area.

Reprints Available

Reprints of the article on "Fundamental Control Concepts" from the December 1958, and January, 1959, issues and of "Fundamental Control Techniques — Frequency Distributions" from the March, 1959, issue, all by Prof. Mason E. Wescott, Rutgers University, are available at 35¢ each. Address RUBBER WORLD, 630 Third Ave., New York 17, N. Y.

THE FIRESTONE TIRE & RUBBER CO.'S president, Harvey S. Firestone, Jr., who is also national chairman of United Service Organizations, is author of an article, "No One Is Alone," which appears in the April issue of *Reader's Digest*. In the article he points out the importance of the USO and magazines like *Reader's Digest* in the field of international understanding. The article was timed to appear during the annual observance of USO month in April.

THIOKOL CHEMICAL CO.'S Rocket Division, Bristol, Pa., has appointed C. Itoh & Co., one of Japan's leading trading companies, as its distributor in Japan. C. Itoh is also distributor in Japan for Douglas Aircraft, Hughes Aircraft, Beech Aircraft, Bendix Aviation, and other companies in the aviation and rocket industries.

POLYMER CORP., LTD., Sarnia, Ont., Canada, has installed what is believed to be the world's largest direct gas-fired, three-pass synthetic rubber dryer. It is unique in having only two gas burners supplying the heat source, and it can be brought to working temperatures within ten minutes. Downtime for maintenance and cleaning between batches has been greatly reduced because of its design which allows complete accessibility to all sections. Designed and built by C. G. Sargent's Sons Corp., Graniteville, Mass., the dryer was erected at the Polymer plant within four weeks.

SEIBERLING RUBBER CO., Barberton, O., achieved a new high in net sales of $48,134,084 in 1958 and a net profit 13% above that of 1957. Earnings per share of common stock were $2.06, as compared with $1.75 in 1957, and this company looks for increased sales and earnings in 1959.

B. F. GOODRICH FLOORING PRODUCTS, Watertown, Mass., has developed a new, popular cream-color which has been added to the rubber tile line for 1959. Available in ⅛- and 3/16-inch, #518, and in 80-gage #218. Samples of this color are now being included in the regular sets of three by three inches and nine by nine inches rubber tile samples. In the molded rubber cove base line, the company is reinstating six colors formerly manufactured on special order only. Working inventories of the following 14 colors for this line are now being carried: plain black, terra cotta, promenade brown, coffee, plain gray, black white, Florentine gray, Morocco, cantaloupe, royal blue, emerald green, Dubonnet, green, and beige.

RUBBER ASSOCIATION OF CANADA has announced that at a meeting of its board of directors on February 12, R. V. Yohe, president of B. F. Goodrich Canada, Ltd., was appointed to the board. He fills the vacancy created some months ago through the resignation of Ira G. Needles.

THE McCORMISH CO., Akron, O., is selling new, rebuilt, and "as is" equipment for use in the rubber industry. In particular, this equipment includes the Mac calender knife and holder, which is claimed to stop all chances of marking or scoring of the calender roll. This device can also be used on a strip mill, without the use of springs or other tension devices. The knives can be furnished in arrowhead types, as well as long taper cutting edge.

UNITED STATES RUBBER CO., New York, N. Y., has introduced a new line of pin core foam cushioning that competes in price with polyether urethane foam, for use as backs and seats on furniture. The foams will be available in blocks four or three inches thick in soft, medium, and firm densities. The four-inch blocks will be manufactured in 78-inch lengths and in six widths—21, 22, 23, 24, 27, and 31 inches. The three-inch blocks, also 78 inches long, will come in 31- and 33-inch widths. Distribution of this new product will be through the fabricating distributors of Koylon foam cushioning.

THE GOODYEAR TIRE & RUBBER CO. OF CANADA, LTD., New Toronto, Ont., has announced that members of Local 232, United Rubber Workers, have voted to accept the terms of a new contract which provides wage increases ranging from 6¢ to 15¢ an hour. Covering 1,650 employes at the New Toronto plant and warehouse, the new one-year contract became effective February 19.

News Briefs

SHELL DEVELOPMENT CO. dedicated its new auditorium at the Emeryville, Calif. laboratories on March 9. The auditorium will seat 295 and is claimed to be the ultimate in design engineering. Shell Development President, H. Gershinowitz, made the dedication, and Joel Hildebrand, University of California, was the guest speaker. The program also included a lecture on "Structure Analysis by Scattered Radiation," by Peter Debye, Cornell University.

CHEMICAL MACHINERY DIVISION, BAKER PERKINS INC., Saginaw, Mich., reports its new 150-gallon heavy-duty vertical planetary mixer, designed primarily for solid propellants, is also suitable for mixing other products, especially those that are abrasive, those easily contaminated, and those that must be compounded in a vacuum. An important feature of the 40-hp., 22-foot machine is the complete elimination of stuffing glands in the mixing area. Thus, when abrasive materials are being mixed, for example, maintenance is greatly reduced. Since there are no glands, feedback is eliminated to prevent batch contamination. The unit can also be used for internal pressure mixing, with some design revisions.

THE FIRESTONE TIRE & RUBBER CO. has completed a new, combination district office, warehouse, and retread shop at 5928 N. Lindbergh St., Hazelwood, a suburb of St. Louis, Mo. The building will be the nerve center of Firestone's sales and distribution activity in the St. Louis and surrounding area which covers most of Missouri and part of Illinois. Malcolm Aitken, district manager at St. Louis, has completed the move of his staff to the new location.

B. F. GOODRICH INDUSTRIAL PRODUCTS CO. will begin expansion of its hose plant at Marion, O., this spring, with completion scheduled before year-end. When in full operation, the expanded plant will enable consolidation of all BFG manufacturing facilities for the types of hose presently produced at the Marion plant.

THE GARLOCK PACKING CO., Palmyra, N. Y., has developed and is marketing Teflon-coated cups for use in hydraulic and pneumatic equipment. The cups are said to reduce the breakaway torque required to operate cylinders; reduce running friction; eliminate sticking to cylinder walls even after prolonged periods of idleness; and eliminate packing chatter and squealing. A thin layer of Teflon provides a coating which becomes an integral part of the packing.

THE B. F. GOODRICH CO.'S RESEARCH CENTER, Brecksville, O., has announced that by adding an improved anti-rad to a rubber recipe, life of conventional aircraft tires can be doubled in radiation service. Aircraft tires that permit safe landings despite exposure to moderately strong doses of nuclear radiation have been developed to serve nuclear-powered aircraft of the future. Anti-rads are chemical materials added to rubber stocks before vulcanization to improve rubber's resistance to radiation damage. Simulated landings on a dynamometer tester, conducted at the United States Air Force's aircraft laboratory of Wright Air Development Center, showed that irradiated tires protected with anti-rad rolled twice as many miles before failure than did irradiated tires without anti-rad.

SEIBERLING RUBBER CO., Akron, O., has announced that treads of all tires in its 1959 passenger-car tire line are being made with a new-type rubber compound said to give substantially improved wear. The company claims that abrasion tests show the new tread rubber will wear longer than any previously known compound in tire manufacture. The firm has trade marked its new tires "Carbojet," after a new process used for the manufacture of the rubber compound. "Carbojet" uses a new synthetic rubber compound produced by Copolymer Rubber & Chemical Corp., Baton Rouge, La. Seiberling is one-seventh owner of the synthetic producer.

JEFFERSON CHEMICAL CO., Houston, Tex., is offering N-methylmorpholine and N-ethylmorpholine for use as (1) catalysts in the preparation of rigid, semi-rigid, and flexible foams under a specification designed to minimize pink color formation in finished foam and (2) as stabilization agents for chlorinated hydrocarbon solvents. These alkylmorpholines are also suggested for use in the preparation of self-polishing waxes, oil emulsifiers, corrosion inhibitors, and pharmaceuticals.

THE GOODYEAR TIRE & RUBBER CO., Akron, O., has announced another step to assist its engineering technical employes to continue their education and to prepare for better jobs. Effective immediately, Goodyear will expand its college tuition assistance program to include full tuition payment for technical and engineering employes at all domestic plants who have completed two or more years of college and who desire to continue their education by working toward an engineering or technical degree. Courses selected under the plan must be taken on the employe's own time and will in no manner interfere with regular work schedule or duties.

THIOKOL CHEMICAL CORP., Bristol, Pa., has been awarded the first definitized contract for a sub-system in the Air Force's Minuteman program, according to Major General Ben I. Funk, Commander of Air Material Commands, Ballistic Missile Center. The contract is in the amount of $77 million and calls for research and development of three stages of the Minuteman solid propellant rocket propulsion system. The majority of the work is to be performed at the company's Utah division at Brigham City, Utah. Some work on the three-stage development will be conducted at the Elkton, Md., plant of Thiokol.

HERCULES POWDER CO., Wilmington, Del., has formed a new applications group to be known as the plastics and elastomers division. The new division, to be headed by John R. Lewis, will be responsible for product development work on thermosetting resins, filled and reinforced plastics, and rubber compounding and evaluation. Hercules is now producing Hi-fax high-density polyethylene, Pro-fax polypropylene, and Penton chlorinated polyether. Also, Hercules has recently acquired the Young Development Laboratories, a manufacturer of filament wound, glass-fiber reinforced, plastic materials.

B. F. GOODRICH AVIATION PRODUCTS, a division of The B. F. Goodrich Co., Akron, O., has been awarded a $2 million contract by the U. S. Navy for full-pressure, high-altitude suits. Garbed in the new Plexiglas-helmeted rubber and nylon suits, Navy pilots can suffer the loss of aircraft cabin pressure in atmospheres bordering on outer space. The suits will be standard equipment for Navy pilots flying at altitudes above 40,000 feet. The suit contains its own communication, oxygen, and ventilation systems, yet retains the required mobility. It was developed and produced by BFG under contract with the U. S. Navy Bureau of Aeronautics. The company made its first high-altitude suit in 1934 for famed pioneer pilot Wiley Post.

THE RUBBER MANUFACTURERS ASSOCIATION, INC., New York, N. Y., has introduced a new feature on the economics of the rubber goods manufacturing industry in its monthly RMA Rubber Highlights Bulletin. Economic data compiled by the RMA Statistical department from published sources each month will cover the following: (1) indices of production; (2) rate of return; (3) rubber consumption; and (4) labor statistics. [RW has incorporated the production indices and rate of return in its statistical section, the other figures were already carried—EDITOR.]

MONSANTO CHEMICAL CO.'S plastics division, Springfield, Mass., has announced that Monsanto Polyethylene 14202 Black has been added to Western Electric Co.'s approved telephone cable jacketing materials. A high molecular weight jacketing compound, Polyethylene 14202 Black has successfully passed several months of rigid laboratory and field performance tests required to meet Western Electric's material specifications.

UNITED STATES RUBBER CO., New York, N. Y., is manufacturing cored foam rubber flat stock in continuous lengths. The new cushioning, which competes in price with polyether foam, can be used for dinette seats, arms, tight backs, and other furniture applications as well as for automobile topper replacements. It will be available in 60-inch widths and in two thicknesses—two-inch and one-inch—and in two compression grades. This cored Koylon flat stock is designed to give furniture manufacturers flexibility and more economical operation for quick production changes. Distribution will be through fabricating distributors and distributors of Koylon foam seating.

THE AMERICAN STANDARDS ASSOCIATION has called a general conference to consider the acceptance of a specification for polysulfide-base sealing compounds for the building trade as an American Standard. The meeting, to be held April 9, will follow the eighth annual conference of the Building Research Institute, to be held in Pittsburgh, Pa., April 7-8. A specification for these sealing compounds has been developed by a technical committee, composed of representatives of 19 companies concerned with polysulfide-base sealants. Chairman of this technical committee is Julian R. Panek, of Thiokol Chemical Corp., Trenton, N. J.

NATIONAL - STANDARD CO., Niles, Mich., has been approved by the board of governors for listing on the New York Stock Exchange, with trading in the stock expected to begin about April 10. Trading will also continue on the Midwest Stock Exchange, where the stock has been listed since 1926. National-Standard is a leading manufacturer of specialty wires, industrial wire cloth, perforated metals, high carbon flat steels, and special machinery.

NEWS about PEOPLE

Howard D. Shorts has been named manager of the urethane foam application laboratory of the Witco Chemical Co. in Chicago, Ill. He was formerly with Hewitt-Robins, Inc., as a urethane foam chemist.

Shelley P. Jones now is manager of truck tire sales for The General Tire & Rubber Co.'s Chicago, Ill., division. He has been associated with General Tire since 1955 as Davenport, Iowa, territory salesman.

Charles E. Lowden has joined the sales staff of the pigments division, American Cyanamid Co., as a sales representative, headquartering at 48 W. 38th St., New York, N. Y. He joined Cyanamid in 1957 as a technical service and sales trainee at the company's Bound Brook, N. J., plant.

R. W. Wettstyne, director of traffic for The Firestone Tire & Rubber Co., Akron, O., has been elected president of the Cleveland Chapter, National Defense Transportation Association. Wettstyne, who served as second vice president last year, was named to the top post at the Chapter's eleventh annual meeting at the Hotel Carter, Cleveland, O.

William R. Swick has been appointed assistant district manager in the New York area for The W. W. Sly Mfg. Co., Cleveland, O. He will headquarter in the firm's office in Jersey City, N. J. He has been in the company's home office for two years, working primarily in the areas of new product development and sales engineering. The firm designs and manufactures dust-control systems, industrial ovens, blast-cleaning equipment, and tumbling mills.

Harold K. Salzberg now is senior scientist at the Borden Chemical Co.'s sales development laboratory in Bainbridge, N. Y. **Louis E. Georgevits** has succeeded Salzberg as head of the laboratory's casein section; while **Curtis Booth,** in addition to his present duties as head of the wood products section, assumes Salzberg's former responsibility for the foundry and abrasive section. **David J. Lieb,** head of the resin section, has been placed in charge of the analytical department.

Edward D. Geise has been made manager of commodity sales for the Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. Geise, formerly assistant manager of commodity sales, replaces **Albert W. Holmberg,** who retired in February. In his new post Geise will direct a group of commodity sales managers who supervise sales, promotion, advertising, and forward planning for all of the Division's 300 products. He will headquarter at the Division's main plant in Naugatuck.

Robert M. Henderson, formerly with the market research department, American Cyanamid Co., has been named director of the market research division of Petroleum Chemicals, Inc., New Orleans, La. He will be responsible for studies of actual and potential markets for chemicals of interest to PCI and also will direct the initial development program on new products. He joined American Cyanamid in 1955 as senior market analyst. Prior to that time he had been affiliated with Jefferson Chemical as a member of the commercial research division since 1948.

E. W. Scott

Earl W. Scott has been appointed coordinator, latex and coatings development, for the Marbon Chemical Division, Borg-Warner Corp., Washington, W. Va. Creation of the new coordinator position results from Marbon's greatly expanded research and development program for latex and coating resins used by the paper, textile, and paint industries. He will headquarter in the recently completed research and development facilities, a part of Marbon's $10 million plant at Washington.

Mahan & Wright

E. G. Isenberg

Bradbury Studio

J. C. Blackwood

E. Glenn Isenberg has been named general sales manager of Neville Chemical Co., Pittsburgh, Pa., assuming the duties of **Alan S. Evans Jr.**, who recently resigned as vice president. Isenberg started with the company 22 years ago in the traffic department. He rose to assistant sales manager and then sales manager.

Herbert F. Schiefer has been appointed chief of the textiles section of the National Bureau of Standards, Washington, D. C., succeeding **William D. Appel**, who retired January 31 after 30 years' service as chief of the section. Dr. Schiefer is noted for his pioneering research in the measurement of physical properties of textile fibers, yarns, and fabrics. He has designed and developed instruments for evaluating the characteristics of various textiles, and many of these instruments are widely used by the textile industry today. In 1950 he was the first recipient of the Harold DeWitt Smith Memorial Award of the American Society for Testing Materials for noteworthy contributions to the fundamental knowledge of textile fibers and fabric structure. He started with the Bureau's textile section in 1929.

Charles Wyman, formerly in charge of tire engineering, has been named tire production manager, The Dayton Rubber Co., Dayton, O. **Charles Moore** has been made manager of tire development; while **Robert Radow** has been assigned the newly created post of technical superintendent. **Elbert Davis** has been appointed chief tire compounder for the Dayton plant. These new positions have been established as part of the company's program virtually to double tire capacity in 1959. Prior to joining Dayton Rubber in 1953, Wyman was assistant manager of tire design for an Akron firm. Moore has had more than 19 years' experience in tire engineering and research work. Radow, a former compounding specialist, will be responsible for processing and quality control. Davis, former senior project engineer for a major Akron tire firm, will be responsible for all rubber and chemical components of tire manufacturing.

John C. Blackwood has been added to the executive sales staff of National Polychemicals, Inc., Wilmington, Mass. He was formerly with B. B. Chemical Co. and United Shoe Machinery Corp., where he was primarily concerned with market research. Prior to this service he had been associated with Tennessee Eastman Corp., Hercules Powder Co., and Nashua Mfg. Co. At one time he had also owned his own company, Delta Chemical Co.

Robert W. Pressing has been appointed general manager, new products department, Linde Co., division of Union Carbide Corp., New York, N. Y. He formerly was manager of molecular sieves production and development at Linde Co., Tonawanda, N. Y. In his new position he will be in charge of all production, development, and processes.

R. W. Pressing

C. M. Coffin

Charles M. Coffin has been made vice president-manufacturing for B. F. Goodrich Industrial Products Co., Akron, O. He succeeds **Rollin D. Hager**, who is on extended leave of absence. Coffin was previously superintendent of manufacturing services for B. F. Goodrich Footwear & Flooring Co., Watertown, Mass.

F. G. Willmot has been appointed director of a new management engineering department of The Goodyear Tire & Rubber Co. of Canada, Ltd., New Toronto, Ont. The department will study and evaluate procedures and systems and the effective utilization of personnel. Succeeding Willmot as manager of the general products division is **W. Goldwin Britt**, formerly manager of the company's molded and extruded rubber department. His responsibilities include the sales of industrial rubber products, foam rubber products, films and packaging materials, shoe products, and molded and extruded rubber.

G. P. Oldham has been named vice president in charge of marketing for Barrett Division of Allied Chemical Corp., New York, N. Y. He had been serving as vice president and general sales manager of Gustin-Bacon Co.

John Getgood has been made manager of the recently formed foreign sales and development department of Phillips Petroleum Co., with headquarters at 80 Broadway, New York, N. Y. **M. W. Conn** has been advanced to assistant manager of the new department, and **A. D. Fischbeck** to manager of patent licensing and market development. **R. J. Hull** has been promoted to manager of rubber chemicals and plastics sales; **R. E. Elliott** and **R. G. Askew**, to assistant managers of these sales; and **R. O. Nagel**, to manager of the Sao Paulo, Brazil, office. **A. E. Buell** succeeds Conn as manager of the market development division of the research and development department; while **O. D. Edwards** replaces Fischbeck as manager of that division's patent and process licensing branch.

A. G. Hill has been named manager of the Bound Brook, N. J., plant of American Cyanamid Co. Dr. Hill has been with the company since 1932, when he started as a research and development chemist. In addition to other capacities, he has served the plant as resident technical director, manager of the pharmaceutical manufacturing department, and assistant plant manager.

Albin S. Krivitsky, associated with the rubber industry for the past 18 years, has joined the synthetic rubber and rubber chemicals technical service department of Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn. Previously he had been technical superintendent for Boston Woven Hose & Rubber Co.

Reginald P. Perry has been appointed vice president of both Lukens Laboratories, Inc., Newton, Mass., and its associate corporation, Skinner & Sherman Co., Inc. He was with UBS Chemical Corp. for the past 17 years, during which time he served as chief chemist, market research director, sales manager of shoe chemicals division, general sales manager, director of marketing for both domestic and export sales, and as a member of the executive committee.

G. P. Oldham

R. P. Perry

R. S. Savage

J. Platner

C. O. McNeer, general sales manager of the chemical division, The Goodyear Tire & Rubber Co., Akron, O., has announced three organization changes, involving **John Platner, R. S. Savage,** and **W. F. Overberger.** Platner joins the rubber and rubber chemicals department as a senior sales engineer. He will be responsible for sales liaison of rubber chemicals and will be in charge of technical sales service for these materials. Savage has been assigned as senior sales engineer in the coatings department, where his responsibilities will include sales service work pertaining to sales of latices to the paint, paper, and textile industries. Overberger has been transferred to the division's development department where he will be responsible for liaison on technical developments involving Plioflex synthetic rubbers.

David H. Allen, general contracting manager, United States Rubber International Division, New York, N. Y., and **John N. Hart,** controller, The B. F. Goodrich Co., Akron, O., have been elected to membership in the Controllers Institute of America, New York, N. Y.

Homer A. Smith has been appointed assistant manager, chemical distributor operations, Minerals & Chemicals Corp. of America, Menlo Park, N. J. He will be active in providing field technical assistance in the application of aluminum silicate pigments and Attapulgus clays which are widely used in the rubber, plastics, inks, adhesives, and other chemical products industries.

John H. Bins has been made manager, automotive sales, by the mechanical goods division, United States Rubber Co., New York, N. Y. He will direct sales of molded rubber goods, Timing and V-belts, rubber-like extrusions, shrink-fit tubing, and other new products to automobile and truck manufacturers and other automotive industry suppliers. He comes to the rubber company after a varied administrative and sales career in the Midwest and New York and will headquarter in the New Center Building, Detroit, Mich.

Larry Damour has been appointed district sales manager for the Cleveland, O., territory for Hobbs Mfg. Co., Worcester, Mass. Damour, formerly the company's Worcester plant sales engineer, replaces **Howard Lambert,** who recently became Hobbs' general sales manager. Damour services the district of Ohio and upper New York State, east to Rochester. He supervises sales and service of Hobbs engineered cutting and engineered winding equipment and die presses from his new base at Cleveland.

Willard E. Fabing has been named vice president of the engineering and technical division of Burton Rubber Processing Co., Burton, O., according to **C. W. Carroll,** president of the company. Fabing will supervise the Burton custom compounding laboratory which is available to clients for consultation and assistance.

W. E. Fabing

J. W. Ferguson

James W. Ferguson becomes manager, field sales, of the Durez Plastics Division of Hooker Chemical Corp., North Tonawanda, N. Y. He will be responsible for carrying out the overall sales plans of the division through the field force, with all district sales managers reporting directly to him.

Robert L. Duncan has been appointed director—product marketing, Union Carbide Chemicals Co., division of Union Carbide Corp., New York, N. Y., and joins the five-man marketing committee and directs a group which, acting in close liaison with the industrial sales force, is responsible for market planning, budgeting, forecasting sales, and sales analysis. **Robert C. Boltz** has been named sales manager in charge of Carbide's sales forces; while **Philip G. Magnusson** has been made product sales manager for plasticizers, monomers, and higher alcohols.

Arthur K. O'Keefe has been elected president, by the board of directors, of Texas-U. S. Chemical Co., New York, N. Y., jointly owned by The Texas Co. and United States Rubber Co., effective March 4. He has been associated with U. S. Rubber's chemical division since 1940.

N. J. McCracken, assistant manager of the research and development division, will assume responsibility for the overall program under **E. J. Buckler,** vice president-research and development, for Polymer Corp., Ltd., Sarnia, Ont. **H. L. Williams,** who has been appointed projects manager, is responsible for the activity in the major fields of research and development, each of which will be under a project supervisor. The reorganization of the division is an indication of Polymer's reaction to the rapidly expanding competition in the synthetic rubber field.

Donald R. Long has been named plant manager of the Borden Chemical Co.'s expanded coatings and adhesives operation in Illiopolis, Ill. Long, formerly plant superintendent at Borden's Polyco-Monomer operation in Leominster, Mass., assumed his new duties April 1. He will be assisted by **R. M. Austin,** area superintendent. **J. D. Kirby** will be production engineer. **D. O. Twiss** has been named assistant plant superintendent and **C. B. Wyman,** process engineer, both at Leominster.

Mervin J. Kelly, chairman of the board of directors of Bell Telephone Laboratories, New York, N. Y., retired March 1 after 41 years of scientific and administrative service with the Bell Telephone System. One of the nation's leaders in the field of industrial research, Dr. Kelly began his Bell System career in 1918 as a research physicist with the research division of the Western Electric Co.'s engineering department. This department was later incorporated as Bell Telephone Laboratories.

David L. Matthews has been appointed manager of manufacturing of Goodrich-Gulf Chemicals, Inc., Cleveland, O. Previously he had been plant manager of the general chemicals plant of B. F. Goodrich Chemical Co. since 1951. In 1954 he was sent on special assignment to England to supervise a polyvinyl chloride plant expansion. He returned here in August, 1955, to resume his duties as plant manager at Avon Lake, O. He had started with Goodrich-Gulf in October, 1955.

Pach Bros., N.Y.

A. K. O'Keefe

Madison Geddes

D. L. Matthews

News about People

R. Saccoman

A. W. Colley

Ralph Saccoman has been appointed vice president, special assistant to the president in charge of operations, and **Arthur W. Colley** has been named vice president—manufacturing for Mastic Tile Corp. of America, Vails Gate, N. Y. The firm's products include rubber, vinyl, asphalt, and vinyl-asbestos tile. Since 1947, Saccoman has been the firm's vice president in charge of manufacturing. Colley comes to his new position with a 24-year background in the smooth-surface flooring industry.

Leonard E. Canner has been elected vice president-production of The Landers Corp., Toledo, O., by the board of directors. He joined the corporation in 1952 as assistant superintendent and in 1956 was elected assistant vice president in charge of production.

George B. Coale and **Graham W. Corddry** have been elected directors of National Lead Co., New York, N. Y., succeeding **George L. Ratcliffe** and **Leonard T. Beale.** Coale is a vice president of National Lead and general manager of the Baroid Division. Corddry is manager of National Lead's Titanium Division.

W. D. LaDue, veteran plant engineer at The Goodyear Tire & Rubber Co., Akron, O., has retired following 42 years of continuous service with the firm. During this time, LaDue was in charge of building 18 factories, including plants in Argentina, Brazil, Java, Sweden, Colombia, Venezuela, Mexico; Topeka, Kan.; Jackson, Mich.; St. Marys, O.; Litchfield Park, Ariz.; Houston, Tex.; and Decatur, Ala.

John C. MacLeod has been assigned the newly created post of assistant to the president in charge of operations for the Barrett Division, Allied Chemical Corp., with headquarters in New York, N. Y. MacLeod, who will be in charge of manufacturing, engineering, purchasing, and related functions, was formerly assistant director of operations for Allied's Solvay Process Division. He has been with the company since 1925.

J. W. Keener, president of The B. F. Goodrich Co., Akron, O., was reelected a board member of the National Industrial Conference Board for a term of one year at the Board's 392nd meeting held recently in New York, N. Y. The Conference Board, founded in 1916, is an independent and non-profit institution for business and industrial fact finding through scientific research.

George J. Stritch has been named the Detroit, Mich., representative of Tyrex, Inc., a voluntary, non-profit organization representing five major manufacturers of the revolutionary new viscose tire cord. Stritch, formerly with the tire yarn division of American Viscose Corp. and with The B. F. Goodrich Co., will maintain liaison with automotive manufacturers in connection with original equipment tire needs.

G. J. Stritch

F. W. Turner

Frank Wesley Turner has been made technical sales representative for butyl rubber for The Enjay Co., marketer of petrochemicals. Turner, who will be based at Enjay's Akron office and cover that district, has been associated with the rubber industry since 1951.

John J. Paredes has joined the sales force of Geigy Industrial Chemicals, division of Geigy Chemical Corp., headquartering in St. Louis, Mo. Previously he had been associated with Monsanto Chemical Co., where he was engaged as sales supervisor for the organic chemical division's special chemical department and as a member of the advertising and sales promotion staff.

Tice B. Woodcock has been appointed purchasing agent of The Okonite Co., Passaic, N. J., wire and cable manufacturing subsidiary of Kennecott Copper Corp. Woodcock, previously assistant to the director of purchases, will be stationed at the firm's Passaic, N. J., headquarters. Also, **Kenneth T. Gordon,** director of purchases, is resigning from the firm, effective April 30. **John L. Fabiny** has been named assistant purchasing agent.

Carl I. Gochenour, manager of product development-chemicals since 1957, has been appointed general manager-product development, Hooker Chemical Corp., Niagara Falls, N. Y. He will be in charge of the group handling evaluation and development of all new products, including chemicals and plastics. Also, **Thonet C. Dauphine,** manager of product development-plastics, has accepted a position in the general development department specializing in the area of economic development.

David J. Beaver, designated the first senior scientist of Monsanto Chemical Co., St. Louis, Mo., in 1949, was one of four senior scientists who recently was awarded a certificate by the company. He has been with Monsanto since 1933, when he joined the Rubber Service Department at Nitro, W. Va. He became research director of that department in 1942. He holds a Ph.D. degree in chemistry from Columbia University.

Chester J. Noonan, vice president of United States Rubber Co., has accepted the chairmanship of the rubber products division for the New York Red Cross Chapter's 1959 fund campaign, it was recently announced by J. M. Curto, manager of sales in New York for U. S. Steel Corp. and chairman of the heavy industry section for the campaign.

S. C. Coleman, chairman of the board of directors, and **R. W. French,** president, have announced that four new vice presidents were elected at the March 17 board meeting of United Carbon Co., Wilmington, Del. **A. G. Treadgold,** associated with United Carbon since its formation, has been elected vice president—manufacturing; **H. B. Lawson,** the firm's controller, becomes vice president—finance; **John H. McKenzie,** who has headed its research and development activities since joining United Carbon last April, has been chosen vice president—research and development; and **Frank Lindeman, Jr.,** general manager of United's gas and oil operations, has been named vice president—gas and oil.

A. G. Treadgold

J. H. McKenzie

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News about People

I. B. Terjesen has been named a division manager at Akron Plant 1 of The Firestone Tire & Rubber Co., Akron, O. **P. J. Durosko,** general foreman in the fabric sub assembly department, takes the post of manager of the tire curing department, the position previously held by Terjesen. The latter will be in charge of all operations in the tire building and tire curing departments at Plant 1.

William A. Morton has been appointed assistant research manager in the organic chemicals research laboratory, Dewey & Almy Chemical Division, W. R. Grace & Co., Cambridge, Mass., according to **Victor S. Frank,** research manager. Morton fills a newly created position. He will be in charge of research administration in the areas of existing product and new product research, development, and technical service.

Thomas J. March has been appointed manager-sales for the silicone products department, General Electric Co., Waterford, N. Y. He succeeds **John T. Castles,** now general manager of the chemical development operation of the company's chemical and metallurgical division. March was formerly manager-materials and devices sales for the G-E specialty electronic components department in Auburn, N. Y.

Ernest M. Ikirt has been elected treasurer of the Lee Rubber & Tire Corp., Conshohocken, Pa., by the board of directors. Ikirt, who has been general manager of Lee's Republic Rubber Division, Youngstown, O., succeeds **Daniel H. Handy,** who is retiring.

W. Connor Cronin has been named control manager of the Naugatuck, Conn., plant of the Naugatuck Chemical Division, United States Rubber Co. In his new post he replaces **Eric C. Kerner,** who is retiring after 47 years with the rubber company.

Anthony W. Webner, II, has been appointed director of racing for The Goodyear Tire & Rubber Co., Akron, O. **C. D. Evans,** former racing-car driver, will continue as field supervisor in the racing tire division.

Ben M. Stephens, manager of The Goodyear Tire & Rubber Co.'s Lincoln, Neb., plant, has been named to replace **A. A. Teisher,** manager of the company's molded and extruded rubber and plastic products plant at St. Marys, O. The appointment is effective July 1, when Teisher retires after 43 years of service. **Daniel R. Remigio,** production superintendent for the rubber belting plant at Lincoln since 1956, has been promoted to plant manager there.

Thomas A. Williams has been appointed assistant to the general manager; **W. S. Gillon,** plant manager; and **William K. McPherson,** production manager, molded products division, Stauffer Chemical Co., San Francisco, Calif.

James L. Gallagher, Jr., and **F. Laurence Mangold** have joined the engineering department of Mobay Chemical Co., Pittsburgh, Pa. Gallagher previously was employed by the Munising Paper Co., of Michigan, as a chemical engineer. Mangold previously worked for the U. S. Geological Survey, the Mine Safety Appliances Co., and Blaw-Knox Co., all of the Pittsburgh Area.

Charles W. Duffy has been elected executive vice president of The Standard Products Co., Cleveland, O. Duffy, who joined Standard Products a year ago as vice president and a director, has been in charge of long-range growth planning for the large automotive parts and building products firm.

J. J. Robson, director of tire engineering and development of The Firestone Tire & Rubber Co., Akron, O., has been elected president of The Tire & Rim Association, Inc. He succeeds **Paul G. Hykes,** of Budd Co., Detroit, Mich. Robson was elected to the presidency at a recent meeting of the Association's board of directors in Akron. The Tire & Rim Association sets industry-wide standards for tires and rims.

Ralph T. Hickcox has been appointed technical assistant to the president of Oliver Tire & Rubber Co., Oakland, Calif., and **Russell D. Kettering** has been named manager of technical services. These promotions emphasize the continuing expansion of the technical growth of this company. Both Hickcox and Kettering's responsibilities are closely coordinated with marketing and development of new products.

Thomas H. Smith, manager of the chemicals and pigments purchasing department of The B. F. Goodrich Co., Akron, O., has been selected honor buyer of the year by the Chemical Salesmen's Club of Cleveland, Inc., Cleveland, O. Smith was named for outstanding performance in developing broader understanding and greater cooperation between purchasing and sales personnel in the chemical industry in northeastern Ohio.

John D. Upham, senior patent attorney, has been named assistant director of the patent department, Monsanto Chemical Co., headquartering in Dayton, O. His appointment fills the vacancy caused by the retirement of **Herbert J. Krase.**

Charles E. Lowden has joined the sales staff of the pigments division, American Cyanamid Co., as a sales representative for the metropolitan New York, N. Y., area. He had been a technical service and sales trainee at the company's Bound Brook, N. J., plant.

OBITUARIES

Paul Weeks Litchfield

Paul Weeks Litchfield, 83, honorary chairman of the board for The Goodyear Tire & Rubber Co., Akron, O., since retirement last October, died March 18 in Phoenix, Ariz., from an embolism. Known as the dean of America's rubber industry, Mr. Litchfield rose from a $9-a-week engineer to the posts of chairman of the board and chief executive officer of Goodyear during his notable career.

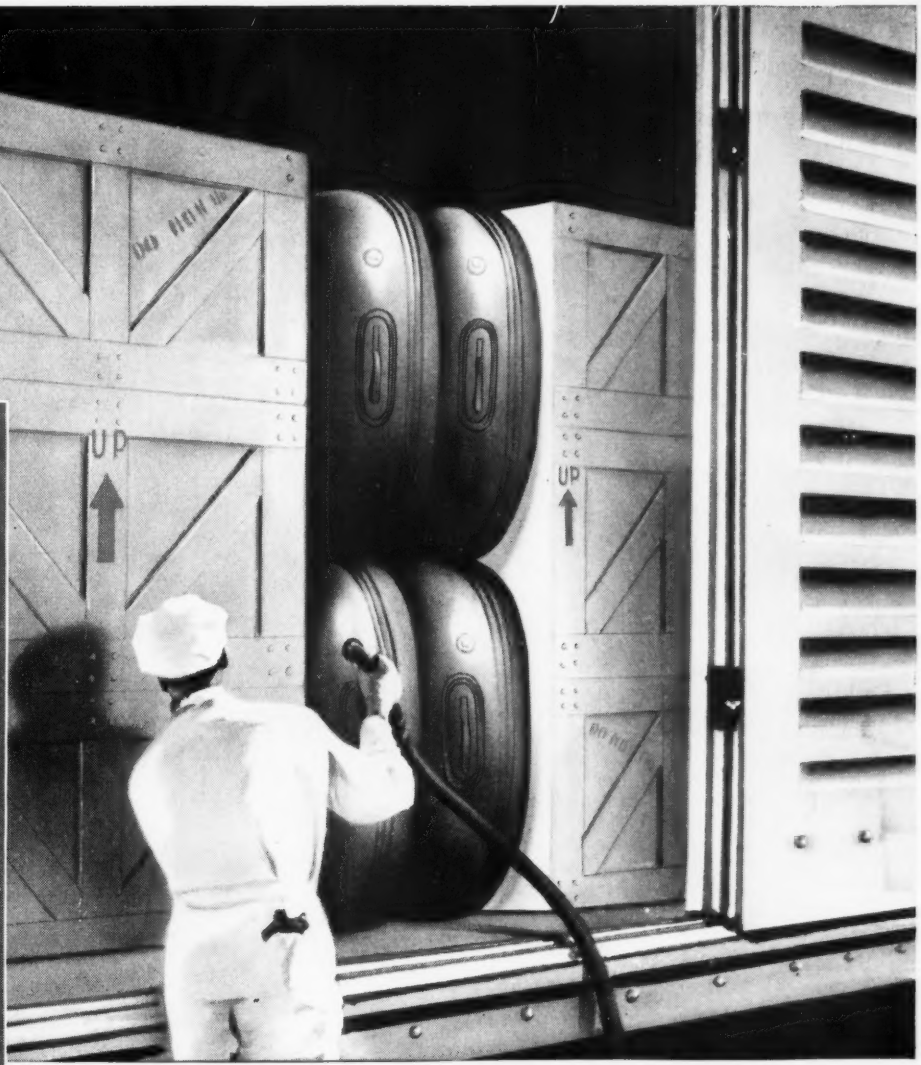
In 1900, Litchfield joined Goodyear, then an infant in industry, which was to become first, the largest builder of tires and, later, the world's largest rubber manufacturer. He had completed 58 years of service when he retired last October, at which time he was named honorary chairman of the board.

Mr. Litchfield was born in Boston, Mass., on July 26, 1875, and attended the Boston public schools. He was graduated from Massachusetts Institute of Technology in 1896 with a Bachelor of Science degree in chemical engineering.

He started with Goodyear as superintendent of all production, development and engineering, became factory manager in 1911, a vice president four years later, and was elected president in 1926. He was named chairman of the board as well as president in 1930, but relinquished the latter post in 1940.

Among other notable accomplish-

U. S. Shor-Kwik inflatable dunnage by U. S. Rubber Co. uses Wellington Sears nylon fabric.



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Obituaries

Paul W. Litchfield

ments was establishment of a Goodyear development department from which has come outstanding contributions to the tire industry such as the first straight-side tire, first cord tire, first pneumatic truck tire, and many others, according to the firm. The deceased played a major part in the vast American program of synthetic rubber production, urgently needed during World War II. He also was active in the field of aeronautics as a champion of both the airplane and the dirigible.

Personal interests included civic and Masonic affairs and the Boy Scouts of America. He received numerous awards—both domestic and foreign—in recognition of his contributions to the rubber, automotive, and aeronautical sciences, as well as to the economic and spiritual public welfare. A testimonial dinner to honor his many accomplishments was held in Akron as recently as last December.

Funeral services were held in Akron on March 23, and interment followed at Akron's Rose Hill Cemetery. Memorial services were conducted also at Mr. Litchfield's Arizona ranch and in the 2,000-seat Goodyear Theater in Akron. All Goodyear plants and operations worldwide observed a period of silence at the time services started in Akron.

In addition to eight active pallbearers, associates in Litchfield's long business career, for the services held in Akron on March 23, there were 54 honorary pallbearers, men of business, industrial, and community leadership from Akron and many other parts of the world. These latter included the heads of the Firestone, Goodrich, U. S. Rubber, General Tire, Seiberling, and Mohawk rubber companies, the president of the Rubber Manufacturers Association, the general president of the United Rubber Workers Union, the head of Knight Newspapers, Inc., and the Akron city officials.

Messages of sympathy were received from all over the world by Mr. Litchfield's family in Akron from presidents, governors, ambassadors, mayors, industrialists, and from people in all walks of life.

He is survived by his wife, two daughters, and grandchildren.

A. L. Viles

A. L. Viles, former president of The Rubber Manufacturers Association, Inc., from 1935 until his retirement in December, 1954, and general consultant to the RMA since that time, died March 12 at a New Rochelle, N. Y., hospital, after a brief illness. He had suffered a cerebral hemorrhage on March 7 at his home in New Rochelle.

Mr. Viles had been associated with the rubber industry in the United States since 1919 and was widely known in both the rubber producing and rubber consuming countries throughout the world.

He began his business career in New York, N. Y., in 1910 as a special agent for the Official Classification Committee for the Eastern Railroads. In 1918 he became secretary and general manager of the traffic committee of the Rubber Association of America. In 1919 he served for four months in reorganizing the Trunk Line Association's Weighing and Inspection Service for Eastern Railroads, returning to the Rubber Association in July, 1919, as secretary and general manager. In January, 1935, he was elected president of the successor organization, the RMA.

In the 1930's and until it was dissolved during the World War II period, Mr. Viles served as the industry observer for the United States at meetings of the International Rubber Regulation Committee which met frequently in London. He served as an industry advisor to the United States representative at meetings of the International Rubber Study Group from the time it was organized in 1943 until 1953. He also served as an advisor to the Rubber Reserve Corp. of the Reconstruction Finance Corp. during World War II and spent much of his time in Washington during those years. He was on industry advisory groups to the Defense Department, the Department of Commerce, and the General Services Administration.

Mr. Viles was an honorary member of the American Society of Association Executives and of the Automotive Old Timers, Inc. He was a member of the Union League Club, Wykagyl Country Club, and was a Knight of the Equestrian Order of the Holy Sepulchre of Jerusalem. For many years he served as president and chairman of the New Rochelle Hospital Association.

The deceased was born in Orland, Me., December 20, 1881.

Blackstone Studios

A. L. Viles

Solemn high requiem Mass was sung on March 14 at the Holy Family Church in New Rochelle. Interment was in Gate of Heaven Cemetery, Valhalla, N. Y.

A widower, Mr. Viles is survived by a sister and two nieces.

Luigi Emanueli

Luigi Emanueli, vice chairman of the board of Pirelli, S.p.A., Milan, Italy, died on February 17 in Milan after a brief illness. He was associated during the past half century with some of the most eminent achievements and experimental research developments in the electrical engineering field—among them the invention of oil-filled cables for extra-high voltage, known as the Emanueli cable.

In addition to developing the Emanueli cable, he conducted experiments in other fields, particularly that of telecommunication cables. In 1910 the deceased designed an aerial telephone cable which Pirelli put into service between Milan and Grossoto, a distance of 100 miles, and which was the longest telephone cable in the world at that time. He also designed the submarine cables laid between Sardinia and Continental Italy in 1913. More recently he directed the design and manufacture of the submarine telegraph cable suitable for great ocean depths, which was laid in 1953 between St. Vincent, Cape Verde, and Recife, Brazil.

In 1944, Mr. Emanueli was put in charge of Pirelli's rubber tire and technical goods divisions. Finally, in 1954, he became vice chairman of the board of directors of the company, in which office he continued actively until the time of his death.

Mr. Emanueli was born in Milan in

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Obituaries

1883. He was graduated, with a degree in electrical engineering, from Milan Polytechnic Institute in 1906 and the next year joined Pirelli.

John T. Kealy

John T. Kealy, consultant to the Mapico iron oxides unit of Columbian Carbon Co., New York, N. Y., died recently at home in White Plains, N. Y. He was 61 years old.

Associated with the iron oxide sales for 36 years, Mr. Kealy started work as a secretary to Norman Lee Smith, of Binney & Smith, and rose to Mapico iron oxides sales manager. Over the years he was active in a number of the trade associations in the paint and rubber fields.

Mr. Kealy was a member of the Friendly Sons of St. Patrick in New York, a past president of the Holy Name Society and a communicant of St. Bernard's Church in White Plains.

He is survived by his wife, two daughters, and two sons.

Raymond L. Wetzel

Raymond L. Wetzel, a retired director of public relations of The Dayton Rubber Co., Dayton O., died on March 1 as a result of a cerebral hemorrhage.

Mr. Wetzel was born February 13, 1893. He attended Dayton public and high schools and St. Marys College (now the University of Dayton).

He joined The Dayton Rubber Co. on November 30, 1925, and during his career there held the positions of sales, promotion, and advertising; director of advertising; and director of public relations from 1953 until his retirement on March 1, 1958. After retiring he became a consultant for Coyer, Morey, Madden & Ballard, Inc., at the Dayton office.

Mr. Wetzel is survived by his widow, two daughters, and a half-brother.

Funeral services were held March 4 at the Holy Angels Church, and interment was in Calvary Cemetery in Dayton.

L. B. Turner

L. B. Turner, 55, Enjay Co. expert on polymers and plastics, died on March 5 while on a business trip to Louisville, Ky. He was stricken at the Louisville Airport and was pronounced dead when taken to the hospital.

Mr. Turner received his bachelor's degree in chemistry in 1928 from the University of Kentucky, where he was elected to Phi Beta Kappa, and subsequently earned his master's degree in chemical engineering at MIT.

He had been with Enjay, marketer of petrochemicals, and other affiliates of Standard Oil Co. (N. J.) for 27 years and was associated with the development of polymers and other petrochemical products for nearly all that time.

Although named Luther B. Turner, he was known as Jack to both friends and business associates. He was a member of the honorary scientific society, Sigma Xi.

Mr. Turner is survived by his wife, one son, and three daughters.

Funeral services were held in Hartford, Ky., his native city, on March 8, with burial in Mount Carmel Cemetery there.

Ernest W. Dunbar

Ernest W. Dunbar, 78, one of the veteran rubber manufacturing executives who had been associated with the Cambridge Rubber Co., Cambridge, Mass., for more than 40 years, died March 2 at his home in Taneytown, Md.

Mr. Dunbar started his rubber career with the United States Rubber Co., in Boston, Mass. Subsequently, he became associated with Apsley Rubber Co., Hudson, Mass. When that company was succeeded by Firestone Tire & Rubber Co., he was in charge of manufacturing until 1918, when he joined Cambridge Rubber.

Shortly after World War II all operations of Cambridge Rubber in Canada and Cambridge, Mass., were curtailed, and production was confined to the Taneytown, Md., and Littlestown, Pa., plant. Mr. Dunbar continued in charge of manufacturing operations throughout his active years and held many offices including director of Cambridge Rubber Co. Ltd., Canada, vice president and director of Cambridge Rubber Co., also as chairman of its board, and president and director of The Carroll Shoe Co.

Mr. Dunbar is survived by his wife, a daughter, a sister, two brothers, and a grandson.

CALENDAR of COMING EVENTS

April 16

Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.

April 17

Detroit Rubber & Plastics Group, Inc. Detroit Leland Hotel, Detroit, Mich.

April 22-24

American Institute of Electrical Engineers. Eleventh Annual Rubber & Plastics Technical Conference. Sheraton Hotel, Akron, O.

April 24

Chicago Rubber Group. Furniture Club, Chicago, Ill.

May 1

Buffalo Rubber Group and Ontario Rubber Group, CIC. Joint International Meeting. Hotel Sheraton-Brock, Niagara Falls, Ont., Canada.

Division of Rubber Chemistry, Chemical Institute of Canada. Annual Convention. Hotel Sheraton-Brock, Niagara Falls, Ont., Canada.

Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.

May 4

Washington Rubber Group.

May 7

Northern California Rubber Group. Berkeley Elk's Club, Berkeley, Calif.

May 12-15

Division of Rubber Chemistry, American Chemical Society. Biltmore Hotel, Los Angeles, Calif.

May 22

Connecticut Rubber Group. Symposium, "The Use of Rubber in Aeronautical Applications." Rapp's Paradise Inn, Ansonia, Conn.

May 25-27

Chemical Institute of Canada. Forty-Second Annual Convention. Halifax, Nova Scotia, Canada.

June 4

New York Rubber Group. Outing. Doerr's Grove, Milburn, N. J.

June 5

Fort Wayne Rubber & Plastics Group. Outing.

Quebec Rubber & Plastics Group. Outing.

June 9

Buffalo Rubber Group. Golf Outing. Lancaster Country Club, Buffalo, N. Y.

June 12-14

Southern Rubber Group. Desert Ranch, St. Petersburg, Fla.

Rhode Island Rubber Club. Twenty-Fifth Anniversary Outing. The Belmont, West Harwich-by-the-Sea, Mass.

June 19

Akron Rubber Group. Outing. Firestone Country Club.

Boston Rubber Group. Outing. Andover Country Club, Andover, Mass.

June 22-26

American Society for Testing Materials. Annual Meeting. Atlantic City, N. J.

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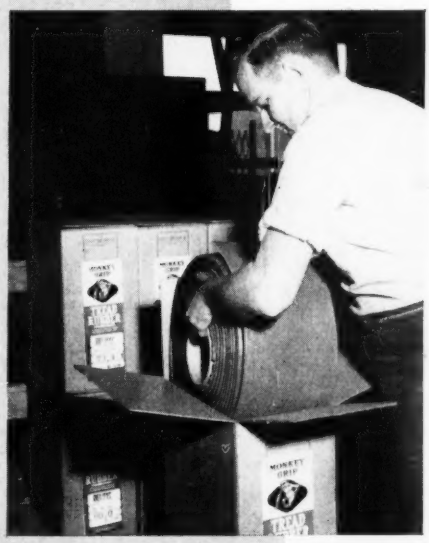

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NEWS from ABROAD

Malaya Expects Double NR Output in 10 Years

Convinced that the world will always need natural rubber because of its special properties and that with the right kind of research and replanting, natural rubber will more than hold its own in competition with synthetic rubber, various leaders in the rubber-planting world recently reaffirmed their faith in the future of the Malayan rubber industry. It is confidently expected that before long Malaya will supersede Indonesia as the world's largest producer of natural rubber, unless Indonesia speedily embarks on a large-scale replanting program.

Sir John Hay, managing director of Guthrie & Co., Ltd., shares this view. He is quoted as predicting in a recent talk at Kuala Lumpur, a significant increase in output by 1965. The outlook for rubber is good, he believes; but he stresses the need of production research and reliance of the industry on efficiency and not on artificial devices like stabilization.

The annual report of the Penang Rubber Trade Association also forecasts marked, early increase in production not only from the maturing of young, high-grade replanted material on estates, but also from the extension of smallholder acreages that has followed fragmentation. It is expected, furthermore, that many estates which closed because of the Emergency, may reopen as increasing areas are declared "white"—that is, completely free of the emergency restrictions imposed to combat Red terrorism.

R. M. E. Michaux, chairman of the International Rubber Research Board and the International Natural Rubber Development Committee, who visited Malaya during his recent tour of Asian rubber countries, is among those who see Malaya shortly ranking as top producer. According to the *Malay Mail*, his optimism for Malaya is based on "the unlimited possibilities for this country where natural rubber is concerned. You have everything on your side, the land, the people, the government, the money, and the know-how."

Mr. Michaux is convinced that Malaya can very much more than double her present production in ten years, which she would have to do, he added, to win the fight against synthetic rubber.

But to be able to do this, "We must pool the brains of all our research units everywhere because the world of today needs teamwork."

For one thing, the "yield barrier," as he put it, which is now about 1,500 pounds per acre, must be cracked, and he is sure this limit can be exceeded by a very large margin. Natural rubber, he feels, has many aces up its sleeve; it can make quicker progress in research so that synthetic rubber would offer little competition in the future.

Mr. Michaux revealed that a five-day international conference of natural rubber research and development experts will be held in Kuala Lumpur late in September. This will be the first of its kind to be held in southeast Asia, and the attendance is expected to include representatives from Malaya, Indonesia, Ceylon, Viet Nam, Cambodia, Nigeria, French Equatorial Africa, and the Cameroons. The conference will deal with present world problems of natural rubber and will aim at coordination of efforts in production and consumption research for natural rubber.

Rubber Estates Sold

About 40 London-registered rubber companies sold their Malayan estates in the past two years, a recent item in the *Straits Times* showed, citing data from the latest issue of the "Manual of Rubber Planting Companies," published annually by the London firm of stockbrokers, Zorn & Leigh-Hunt.

In a fairly large number of transactions, however, estates have been bought by active, rubber-growing concerns, with amalgamation in view, developments which the Manual thinks should be welcomed by investors, as tending to enhance the market rating of their shares. The better-class Malaya rubber stocks have been holding their own, the Manual says, and even now shares in some of the leading companies return 15% or more.

Comment in Malaya was directed chiefly to the amalgamations and tended to minimize the loss of confidence in Malaya implied by the approximately 40 sales referred to. It is accepted that there was a degree of scare-selling just before and just after Malayan independence, but it is suggested that many of the sellers may be regretting their haste.

Locally no lack of interest by investors is seen in rubber estates in Malaya, and estates in good condition find a ready market. Unfortunately, it has to be admitted that in many cases estates are bought for fragmentation.

Indonesia Takes Over Foreign-Owned Estates

The taking over early last February of five British Rubber Estates in Northern Sumatra by local authorities has roused strong feelings in British circles. Robert Saner, the British Chargé d'Affaires, in Djakarta, has discussed the matter with Dr. Djuanda, the Indonesian Premier, who is to give the question his personal attention. The Central Government officials are understood to have denied knowledge of the confiscatory actions.

The concessions on all five estates expired several years ago; when extension of the concessions was requested, the Indonesian authorities replied that no decisions could be made until an agrarian bill was passed by the Indonesian Government. Such a bill has still not been passed, it appears.

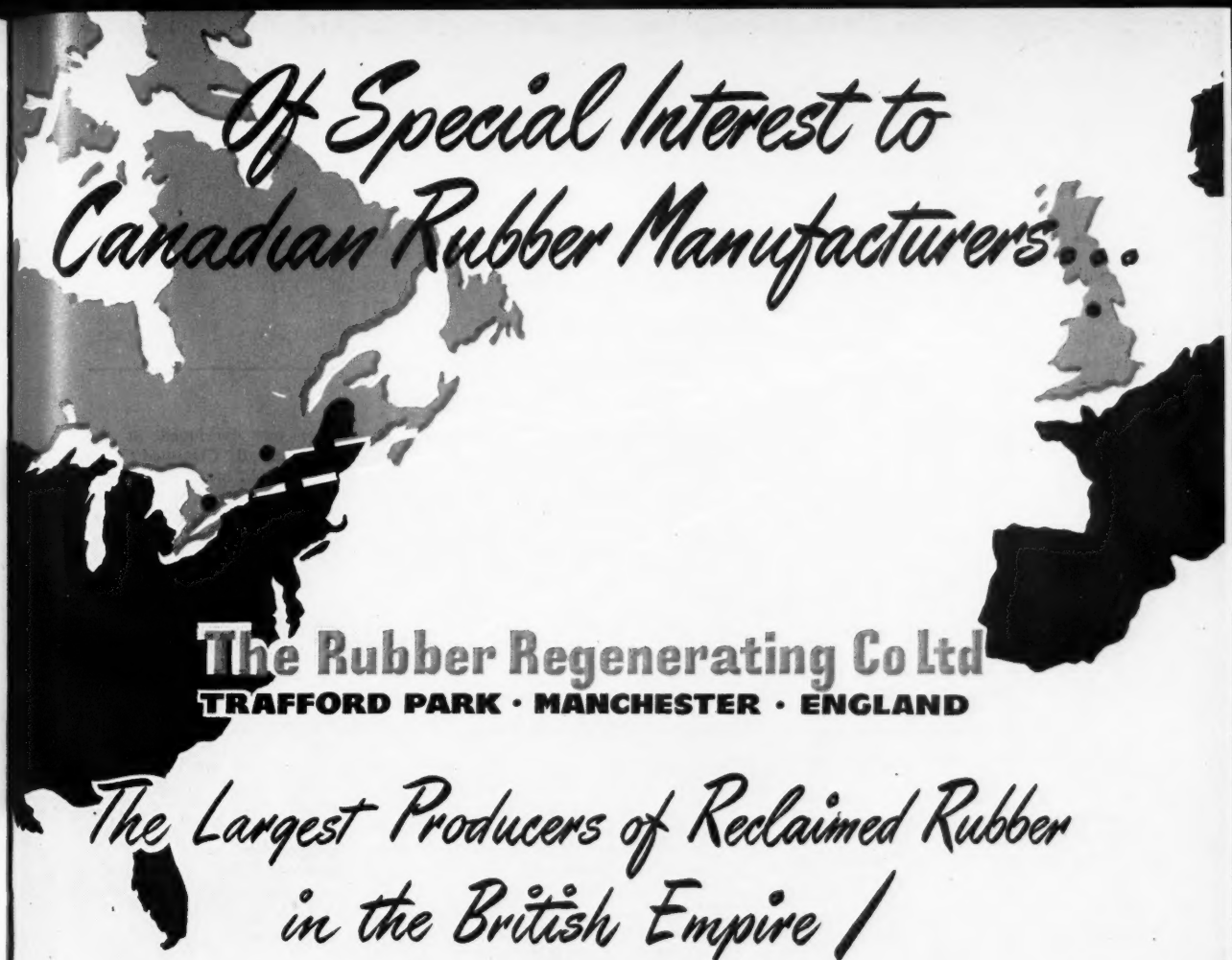
The Rubber Growers' Association, discussing the affair, brought out that one of the estates involved has been replanting with high-yielding trees; also that concessions on at least eight other British estates will be ended by 1961.

Meanwhile the Indonesian Government reportedly was said to be preparing to announce the nationalization of 387 former Dutch enterprises, including tobacco, rubber, and sugar plantations. The announcement was to be in the form of a decree; a further decree was to deal with compensation, and a third was to be issued later on the remaining enterprises.

Reports reaching Singapore on March 7 stated that after two months of comparative inactivity Sumatran rebels resumed attacks on British and Indonesian rubber estates in North Sumatra, concentrating their fury chiefly on estates in isolated areas. Bands of 40-50 guerrillas invaded estates, burning factories, trucks, and stored rubber and looting houses. On one estate they burned 125 tons of rubber.

SBRs and Urethanes

Britain's first large-scale synthetic rubber factory, recently opened at Hythe, near Fawley, by the International Synthetic Rubber Co., now offers its range of cold styrene butadiene rubbers (SBR) under the name of Intols. Presently available are:



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Intol 1710, extended with 37.5 parts aromatic oil to 100 parts of the polymer; it is emulsion polymerized, using the same soaps and stabilizers as for Intol 1502.

At the recent Commercial Motor Show held at Earl's Court, London, Dunlop Rubber Co. for the first time showed a solid tire made from Duthane, the company's rubber-like synthetic material based on polyurethane. Amber in color, the tire is said to be strong, hard wearing, and resistant to greases and oil.

German and British firms are participating equally in the formation of a company which will produce polyurethane rubbers in England. The leading German company processing this material, Lemforder Metallwarengesellschaft m.b.H., and Camp Bird Industries and Knight, Lockhart & Co., have started a new enterprise, Rubber Plastics Ltd., and polyurethanes, to be sold as Vulkollans and Rubplastic, soon will be available from the Rubber Plastics Works at Upper Basildon, Berkshire.

Imports Down, Exports Up in '58 Against '57

Sweden bought less raw rubber and rubber manufactures in the first half of 1958 than in the same period of 1957, official figures show. The overall difference came to 5% in quantity and 10% in value, and most items, including tires and mechanical goods (except belting), were more or less affected.

On the other hand, both quantity and value of exports were about 10% above the 1957 level; tires in this case made a particularly good showing. Business in rubber footwear and rubber-soled shoes, however, fell off.

Imports of raw rubber were 16,578 metric tons, valued at 47,776,000 kroner in the 1958 period, against 17,354 tons, valued at 56,624,000 kroner, the year before. Imports of rubber manufactures fell to 6,026 tons, valued at 43,363,000 kroner, from 6,376 tons, valued at 44,734,000 kroner. Table 1 gives the figures for the principal imports of rubber goods.

The comparative totals for exports were 3,950 tons, valued at 22,779,000 kroner, and 3,502 tons, valued at 20,490,000 kroner, in the 1958 and 1957 periods, respectively. Table 2 shows the exports included.

TABLE 1

	First Half, 1958		First Half, 1957	
	Tons	1,000 Kr.	Tons	1,000 Kr.
Tires	1,834	12,343	2,034	13,865
Hose, tubing, and packing	1,127	9,258	1,238	9,601
Belting	360	3,429	331	3,172
Miscellaneous, including surgicals	265	5,194	317	5,338
Other rubber goods	536	5,923	515	5,594

TABLE 2

	First Half, 1958		First Half, 1957	
	Tons	1,000 Kr.	Tons	1,000 Kr.
Packing, heels, soles, etc.	196	1,232	113	932
Casings for motor vehicles	1,903	12,359	1,575	10,673
Footwear	72	643	81	782
Rubber-soled footwear	36	611	50	838
Other rubber goods	1,743	7,934	1,683	7,265

Pelletized News

The success of a scheme for estate management training, started a few years ago by the Malayan Rural and Industrial Development Authority, has led to its expansion. Trainees, mostly young clerks from commercial firms or government departments, are first taught the theory of rubber planting at the Rubber Research Institute; then they go to an estate where they learn all the operations, from weeding to budgrafting, as well as the duties of foremen and managers. Finally, they are transferred to a rubber factory to become familiar with rubber processing methods. The training period is normally 10-12 months. All trainees so far are said to have found jobs as assistant managers, mostly on European-owned estates.

NANYANG MFG. CO., LTD., Johore, one of Malaya's largest rubber footwear manufacturers, produces 8,000 pairs of shoes and slippers daily. The entire output is sold in the Federation. Prices are below those for Japanese imports, ranging from the equivalent of 30 U. S. cents, for a small pair of Japanese-type slippers, to 75 U. S. cents for a pair of basketball shoes. The light, comfortable Japanese-style slippers have become very popular in Malaya.

No change has developed in the position of Technically Classified (T.C.) rubber in the United States since 1956 is the conclusion of a survey made in September, 1958, by the National Rubber Bureau, Washington, D. C., U. S. A., at the request of the Rubber Research Institute of Malaya. The opinions gathered from six manufacturers, seven New York importers, and three shippers' agents, confirm what the 1956 survey indicated—that big manufacturers show little interest, though some of the smaller firms regularly take a part of their No. 1 RSS requirements in T.C. rubber. Manufacturers as a whole are reluctant to pay a premium for T.C. rubber; the biggest demand in America is for lower grades. The RRI concludes that no great increase in demand can be expected unless more T.C. rubber, especially in the lower grades, is made available without premium.

ROYAL SULFURIC ACID WORKS, formerly Ketjen, Ltd., Amsterdam, will make carbon black in the Netherlands. A new company, Ketjen Carbon, Ltd., is to be formed which will produce blacks under a license agreement with Godfrey L. Cabot, Inc., Boston, Mass., U.S.A., which gives the Dutch firm access to Cabot patents and technical know-how and also entitles it to sell the products all over the world. A 13,000,000-guilder factory is to be erected in the Botlek area of Rotterdam, with initial capacity of about 13,000 tons a year, and a full range of high-quality oil furnace blacks for the rubber industry is to be produced.

A large rayon plant is reportedly to be built in Leningrad by an Italian firm to supply rayon yarn and cord for three new tire plants under construction in Soviet Russia.

A SOUTH AFRICAN SECTION of the Institution of the Rubber Industry will be established with a central council in Johannesburg, and branches in Johannesburg, Durban, and Port Elizabeth; the necessary permission was granted by the IRI Council at a meeting in London, January 27. The new Section will work to promote development of polymer science and technology, to encourage technical education, and to provide a means of association for persons in the rubber industry in South Africa.

(Continued on page 151)

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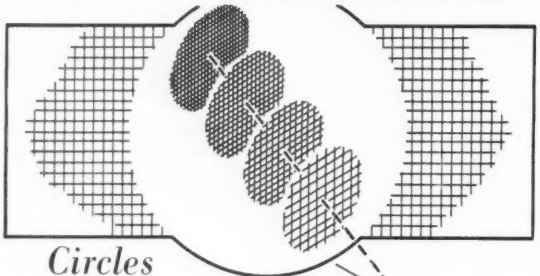

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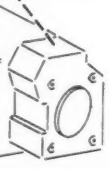

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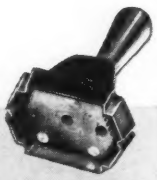

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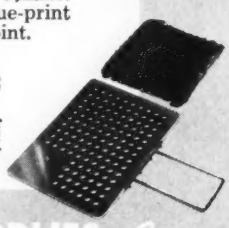

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NEW EQUIPMENT

Almco drum tumbler for rubber finishing

New Almco Tumblers

A series of eight new refrigerated tumbling machines specifically designed for deflashing and finer finishing of molded rubber parts has been announced by Almco, Queen Products Division of King-Seeley Corp., Albert Lea, Minn. Using liquid CO_2 as the refrigerant, the tumblers enable precision, production-line barrel finishing of molded rubber parts to meet the most rigid manufacturing specifications.

Freezing the rubber parts with CO_2 in the insulated barrel imparts a metallic hardness to the parts that greatly facilitates the barrel finishing process. Freezing occurs both before and during the tumbling cycle. Thus this method eliminates hand-trimming of flash from rubber parts that lend themselves to this method.

This method makes possible per piece cost savings up to 75%, according to the company. Also, it gives a high-quality finish of complete uniformity.

The Almco liquid injection method is fully automatic; the flow is controlled by a solenoid valve, and the amount governed by thermostat and timer. The rapid sublimation and uniform dispersion of the liquid CO_2 in barrel result in quick freezing, assuring a minimum time cycle for processing the work load. The automatic thermostatic temperature controls provide for temperatures down to —100° F.

A timer is provided which indicates by signal light when more CO_2 is needed; while a barrel timer controls the length of the tumbling operation. All operating controls are located in a single, easily reached control box.

The eight new Almco models range in size from 3.7 to 30.7 cubic feet barrel capacity. The hexagon-shaped barrels all have three-inch thick insulation, stainless steel liners, and doors with a special low-temperature gasket. All models feature variable barrel speed, ranging from 10 to 30 rpm.

Overall cabinet size ranges from 47 inches long by 40 inches wide by 64 inches high from the smallest model to 71 inches long by 58 inches wide by 78 inches high for the largest. Power requirements are from ½ to 3 hp.

Complete catalog literature, including before and after illustrations of typical rubber parts finished by the new Almco CO_2 method, is available from the company.

ASRC Polymer 1500 at the breakdown time of 2 minutes
Brand A Polymer 1500 at the breakdown time of 2 minutes
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Report on Polymers

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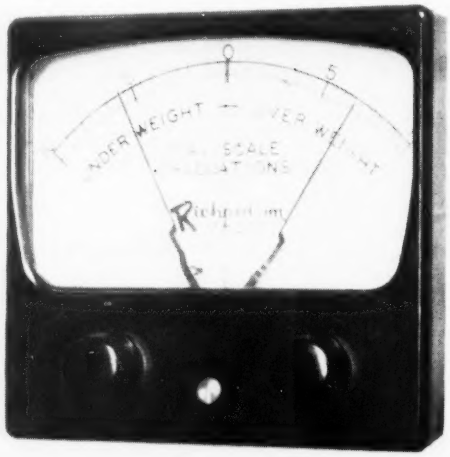
New Equipment

New Richardson Meter

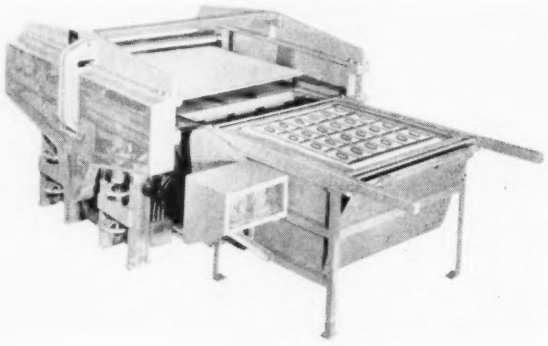
A panel-mounted off-weight indicator that safeguards against spoiled mixtures and batches in automatic proportioning systems has been announced by Richardson Scale Co., Clifton, N. J. Designed for use with the firm's Select-O-Weigh automatic proportioning system, the instrument provides a visual indication of the number of off-weight graduations for each ingredient weighed by the system. This graduated reading makes it possible to correct a trend to overweighing or underweighing before the actual limit of tolerance is reached, thus preventing spoiled mixtures.

Provision has been made for independent adjustment of the overweight and underweight tolerance from one to ten dial graduations. The linearity and accuracy of the meter is plus or minus ½ a dial graduation.

The under-over indicator requires no circuit changes in the installation currently in use for standard under-over systems, according to the company. The indicator unit consists of an electronic chassis that draws its power supply and signal from a standard Select-O-Weigh primary cut-off control relay.



Under-over weight indicator



Femco 60- by 48-inch roller die cutter

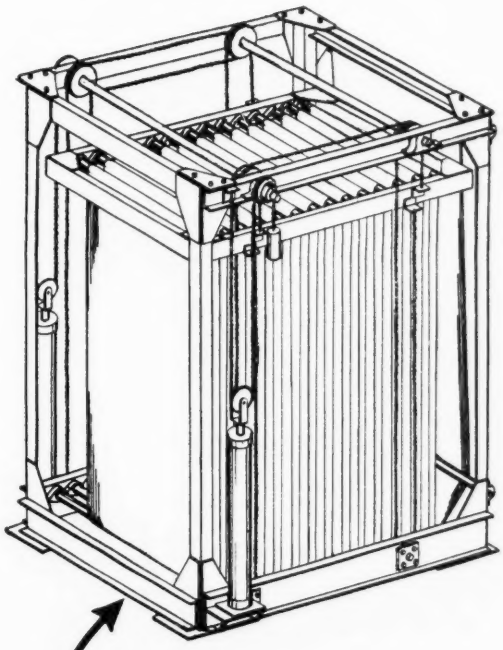
New Femco Die Cutter

The Falls Engineering & Machine Co. has announced a 60- by 48-inch heavy-duty roller die cutter which combines both a vertical and a horizontal die handling mechanism on the model. Heretofore, only one or the other mechanism had been available on the individual die cutter.

Chief advantage of the vertical die handling mechanism is

(Continued on page 160)

TIRE FABRIC PROCESSING EQUIPMENT



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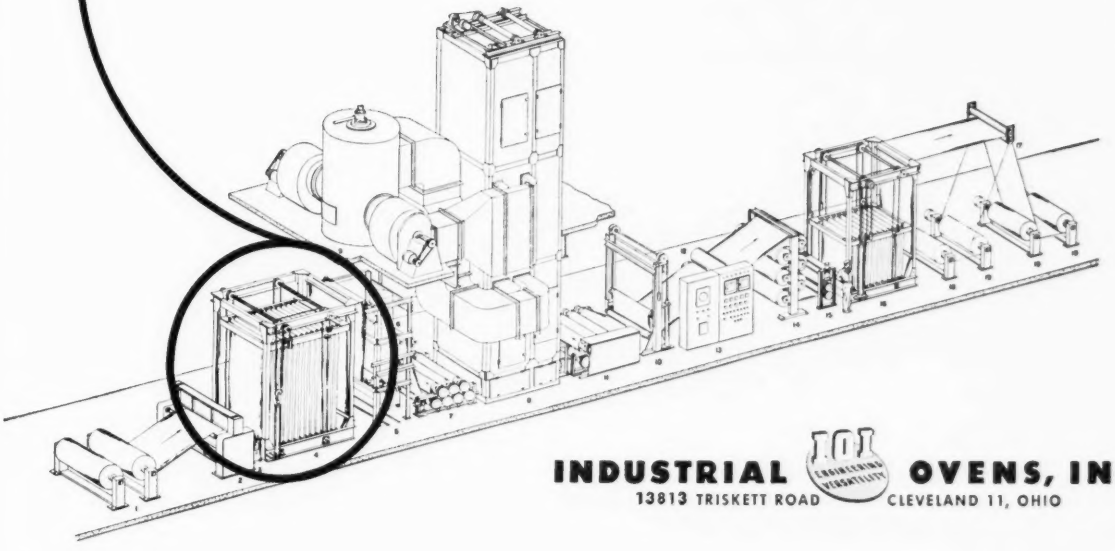

INDUSTRIAL OVENS, INC.
13813 TRISKETT ROAD CLEVELAND 11, OHIO

MARKET REVIEWS

The number of new experimental-commercial SBR grades, particularly black masterbatches, continues high, and many are identified by a variety of coding systems. RUBBER WORLD's most recent tabulation of the standard and specially numbered grades has been forwarded to the producers for their examination and approval and, as soon as replies are received, will be published as a service to consumers and producers alike.

Natural Rubber

During the close of the period under review (February 16-March 15) natural rubber futures market penetrated the 31¢ level, and support appeared at that price. The strength was attributed to current record-breaking consumption rate and anticipation of good demand in the months ahead. Also, the market was steady, with some resumption of Iron Curtain buying in Singapore.

The Tokyo and Kobe rubber exchanges have announced that starting March 2 they will initiate limited trading in #1 Ribbed Smoked Sheets. Both exchanges had been trading in #3 RSS only; whereas the London, Singapore, and New York markets trade in #1 RSS.

Shell Oil Co. and United States Rubber Co.'s joint announcement of the commercial production of synthetic isoprene rubber and of commercial truck tires made therefrom had little apparent effect on the futures market. Companies officials stated that the new development, rather than hurting the natural rubber market, was likely to reduce unpredictable market fluctuations, thus making the rubber fabricating business less risky.

February sales, on the New York Commodity Exchange, amounted to 6,210 tons, compared with 9,950 tons for January contract. There were 18 trading days in February, and 19 during the February 16-March 15 period.

On the physical market, RSS #1, according to the Rubber Trade Association of New York, averaged 30.69¢ per pound for the February 16-March 15 period. Average February sellers' prices for representative grades were: RSS #3, 29.53¢; #3 Amber Blankets, 28.58¢; and Flat Bark, 24.71¢.

REX CONTRACT

1959	Feb. 20	Feb. 27	Mar. 6	Mar. 13
Mar.	30.28	30.55	31.00	30.85
May	30.40	30.65	31.35	31.10
July	30.40	30.70	31.40	31.15
Sept.	30.35	30.70	31.40	31.20
Nov.	30.38	30.65	31.40	31.25
1960				
Jan.	30.38	30.65	31.31	31.15
Mar.	30.40	30.65	31.31	31.25

NEW YORK OUTSIDE MARKET

	Feb. 20	Feb. 27	Mar. 6	Mar. 13
RSS #1	30.13	30.50	31.25	31.00
2	29.88	30.25	31.00	30.88
3	29.63	30.00	30.75	30.63
Pale Crepe #1 Thick	31.50	31.88	31.88	32.38
Thin	32.00	32.25	32.50	32.38
#3 Amber Blankets	28.75	28.88	29.38	29.75
Thin Brown Crepe	28.50	28.63	29.25	29.50
Standard Bark Flat	25.25	25.50	26.13	26.63

Synthetic Rubber

Consumption of synthetic rubber in the United States in February totaled 88,165 long tons, compared with January's consumption of 89,636 tons. Assuming 21 working days in January and 20 in February, consumption per day in February at 4,410 tons was ahead of the 4,260 tons per day in January. Of this 88,165 tons of synthetic rubber used in February, 73,100 tons were SBR; 6,825 were neoprene; 5,330 were butyl; and 2,910 were nitrile rubbers.

Exports of synthetic rubber at 17,750 tons in February were slightly ahead of the 17,491 tons sent abroad in January; the exports of all types except butyl showed an increase. Stocks of synthetic rubber on hand showed some reduction in February as compared with January stocks.

Total new rubber consumption in February at 135,765 tons was somewhat less than the record-breaking January consumption of 139,549 tons. New rubber consumption for the first quarter of 1959 is expected to reach nearly 420,000 tons, of which about 270,000 tons will be synthetic rubber. It is not expected, however, that this rate of consumption will be continued in the second and third quarters, although a fourth quarter about equal to the first quarter might be realized. According to one source, inventories of tires are beginning to accumulate, and some cutbacks in tire production may follow, especially if a steel strike slows down automotive production.

Latex

During the last two weeks of the February 16-March 15 period the natural rubber latex market was quite steady, and fair business in both drum and bulk was transacted. The differential for drum latex has again improved, and with supplies becoming noticeably tighter this upward movement may well continue, according to one source. The general outlook for NR latex appears rather more promising from a producer's point of view than has been the case for some time.

Consumption of natural rubber latex here in January amounted to 7,184 tons, against 6,820 tons in December. Stocks at the end of January stood at 10,025, compared with 8,900 tons at the end of December.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b., rail tank car, ran about 38.21¢ per pound solids. Synthetic latices prices were 21.5 to 38.2¢ for SBR; 37 to 53¢ for neoprene; and 46 to 60¢ per pound for the nitrile types.

Final December and preliminary January domestic figures for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
Dec.	0	*	6,820	8,900
Jan.	0	*	7,184	10,025
SBR				
Dec.	6,891	—	6,893	7,672
Jan.	7,801	—	6,886	7,822
Neoprene				
Dec.	986	0	805	1,563
Jan.	1,049	0	925	1,551
Nitrile				
Dec.	1,033	0	1,106	2,519
Jan.	1,104	0	1,244	2,418

*Not available yet for period covered.

Scrap Rubber

An easier tone pervaded the scrap rubber market during the period under review (February 16-March 15). While scrap continued to move to reclaimers, the latter were beginning to limit their

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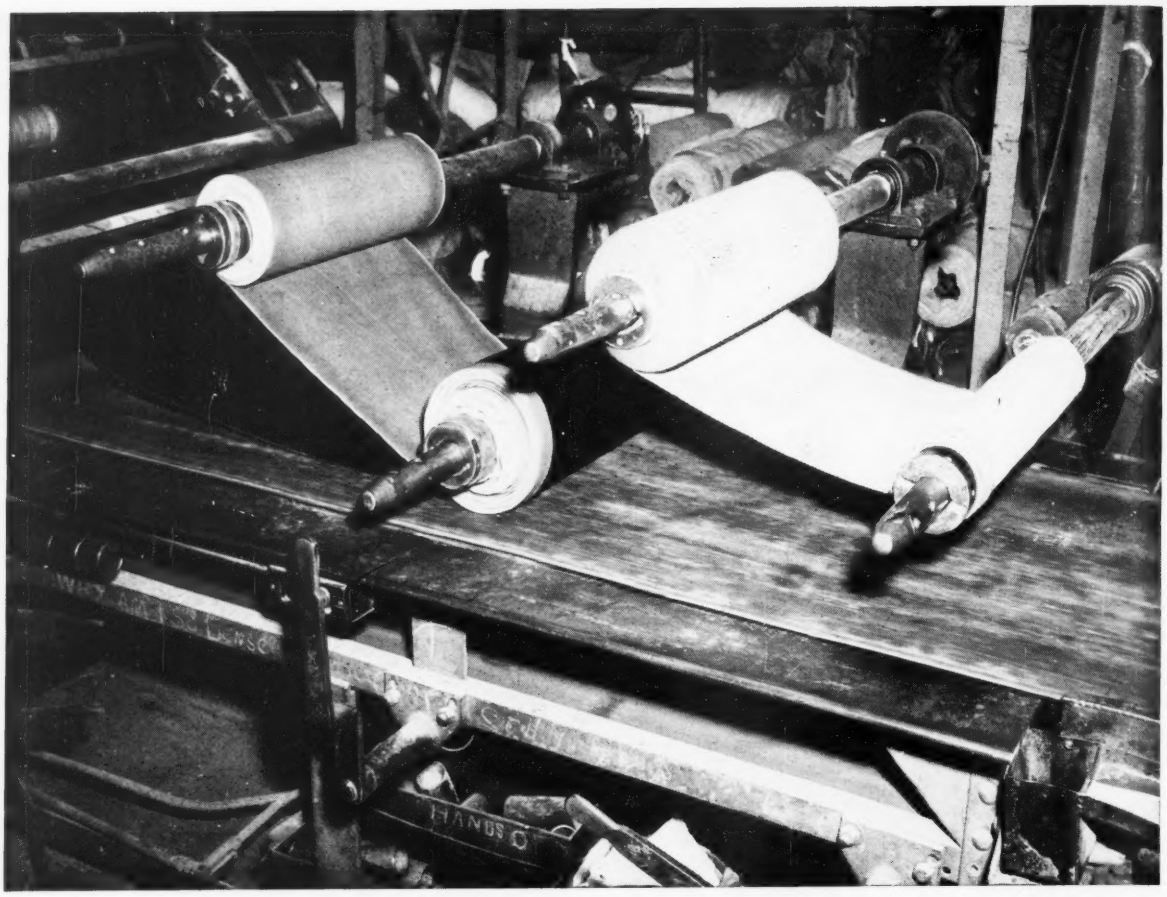

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purchases. Toward the close of this period the slackening consumer demand was felt mainly in the tube section of the market, with prices easing. Mixed auto tubes were quoted at 3.25¢ at both eastern and midwestern points, with synthetic butyl tubes at 4.75¢.

	Eastern Points	Akron, O.
	Per Net Ton	
Mixed auto tires	$11.00	$12.00
S. A. G. truck tires	nom.	15.50
Peeling, No. 1	nom.	23.00
2	nom.	20.00
3	nom.	15.50
Tire buffings	nom.	nom.
	(¢ per Lb.)	
Auto tubes, mixed	3.25	3.25
Black	5.75	5.75
Red	6.25	6.25
Butyl	4.75	4.75

Reclaimed Rubber

So far in 1959 reclaimed rubber sales are exceeding the forecasts made in late 1958. One company reports that its January-February sales were 60% ahead of sales in the same period last year.

Demand by the automotive trade remains at a high level. Consumption of reclaimed rubber has been increased by the original-equipment manufacturers; yet there has been no decline in the consumption in the replacement field. It now appears that this high ratio will be maintained until the production of 1959 models taper off, according to one source. Any labor unrest that might be generated in the rubber industry could upset this pattern.

Another company reports that reclaimed rubber sales between February 16-March 15 have been exceptionally good, and it has been necessary for the company to operate some overtime to keep up with demand. Current orders indicate that business will continue to be good, and if the automobile industry should show a good spring pickup, the company would be busier than ever.

According to The Rubber Manufacturers Association, Inc., report, February production of reclaimed rubber was 25,300 long tons; while consumption was 24,000 long tons.

RECLAIMED RUBBER PRICES

Whole tire, first line	$0.11
Third line	.1025
Inner tube, black	.16
Red	.21
Butyl	.14
Light carcass	.22
Mechanical, light-colored, medium gravity	.155
Black, medium gravity	.085

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity, at special prices.

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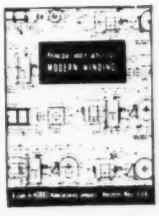

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Market Reviews

Rayon and Nylon

Tyrex, Inc., recently claimed 22-24% more tread mileage for tires using Tyrex viscose cord than for nylon cord tires (see this issue, page 113). According to one source, however, the future for nylon tire cord is bright, and market expansion is expected to continue.

Currently more than one-third of all tires produced are made of nylon cord. For aircraft tires, nylon is used exclusively because of the critical performance requirements of this use. In other than aircraft tires, greatest penetration has been realized in replacement passenger tires and in truck, bus, and off-the-road tires where tire construction and premium pricing opportunities permit nylon to compete on a favorable basis with other cords, according to the same source.

In 1958, reports one leading rayon producer, 71.8% of all tire cord consumed in the manufacture of tires of all kinds was made of cellulosic yarns (rayon and Tyrex viscose yarns); while 26.2% was made of nylon, and 2.0% of cotton. This producer feels that the encroachment of nylon tire cord has been contained. Tyrex has announced a 5% price increase for Tyrex viscose tire cord, effective March 1.

Total packaged production of rayon and acetate filament yarn during February was 54,500,000 pounds, consisting of 25,700,000 pounds of high-tenacity rayon yarn and 28,800,000 pounds of regular-tenacity rayon yarn. Production for January had been: total, 56,100,000 pounds; including regular-tenacity rayon yarn, 30,900,000 pounds; and high-tenacity rayon yarn, 25,200,000 pounds.

Filament yarn shipments to domestic consumers for February totaled 55,000,000 pounds, of which 25,700,000 pounds were high-tenacity rayon yarn, and 29,300,000 pounds were regular-tenacity rayon yarn. Shipments for January had been: total, 56,700,000 pounds; high-tenacity, 25,700,000 pounds; regular-tenacity, 31,000,000 pounds.

There were no additional reported price changes during the period under review.

RAYON PRICES

Tire Fabrics

1100/490/2	$0.625/$0.78
1650/908/2	.685/ .685
2200/980/2	.625/ .655

Tire Yarns

High-Tenacity	
1100/ 490, 980	.66/ .66
1100/ 490	.66/ .66
1150/ 490, 980	.59/ .63
1165/ 480	.59/ .65
1230/ 490	.59/ .63
1650/ 720	.55/ .58
1650/ 980	.55/ .58
1875/ 980	.55/ .58
2200/ 960	.54/ .57
2200/ 980	.54/ .57
2200/1466	.64
4400/2934	.60

Market Reviews

Super-High Tenacity

1650/ 720	$0.60
1900/ 720	.58

NYLON PRICES

Tire Yarns

840/ 140	$1.10/$1.20
1680/ 280	1.20

Industrial Fabrics

Toward the close of the February 16-March 15 period, industrial grey cotton cloth users repeatedly called on mills to ship them portions of the yardages scheduled for later March or April deliveries. To this extent they were giving sources notice that finished product business is greater than had been indicated when initial orders were placed. No great yardage volume was involved in these cases. Industrial goods, however, were being used up faster than many had expected would be the case. Another helpful development was the receipt by mills of contracts covering production through part of the third quarter.

Many discontinued industrial constructions that previously had been carried in stock or had been available in the loom are again coming to life. Since these constructions are no longer to be picked up at buyers' pleasure, the observant buyer has begun to anticipate later requirements. So far only a beginning has come to notice, though well over a million yards are booked.

Industrial Fabrics

Broken Twills*

54-inch, 1.14, 76x52	yd.	$0.52
58-inch, 1.06, 76x52		.585
60-inch, 1.02, 76x52		.5825

Drills*

59-inch, 1.85, 68x40	yd.	.365
2.25, 68x40		.2975

Osnaburgs*

40-inch, 2.11, 35x25	yd.	.2275
3.65, 35x25		.1525
59-inch, 2.35, 32x26		.275
62-inch, 2.23, 32x26		.2875

Ducks

Numbered Duck†

List less 45%

Hose and Belting Duck*

Basis	lb.	.60

Enameling Ducks*

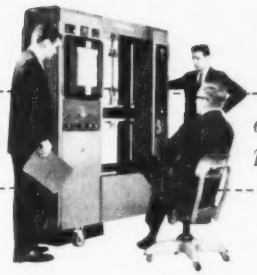
	S. F.	D. F.
38-inch, 1.78 yd.	$0.3263	.3313
2.00 yd.	.275	.28
51.5-inch, 1.35 yd.	.45	.46
57-inch, 1.22 yd.	.4838	.50
61.5-inch, 1.09 yd.	.5413	.5538

Army Duck†

52-inch, 11.70 oz., 54x40 (8.10 oz./sq.yd.)	yd.	.5925

*Net 10 days.
†2% 10 days.

INSTRON



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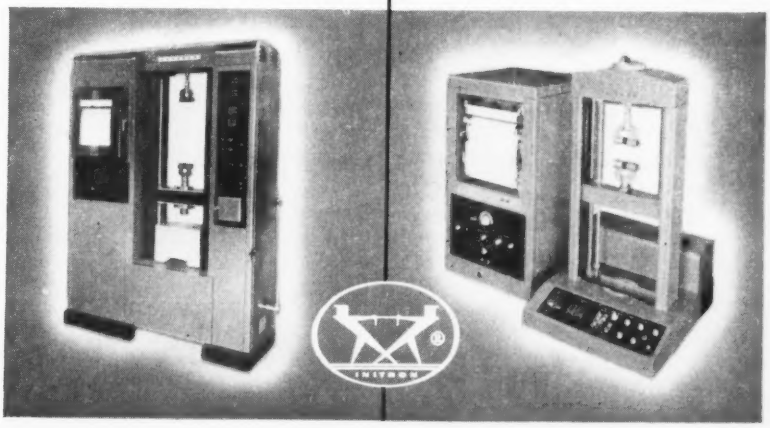

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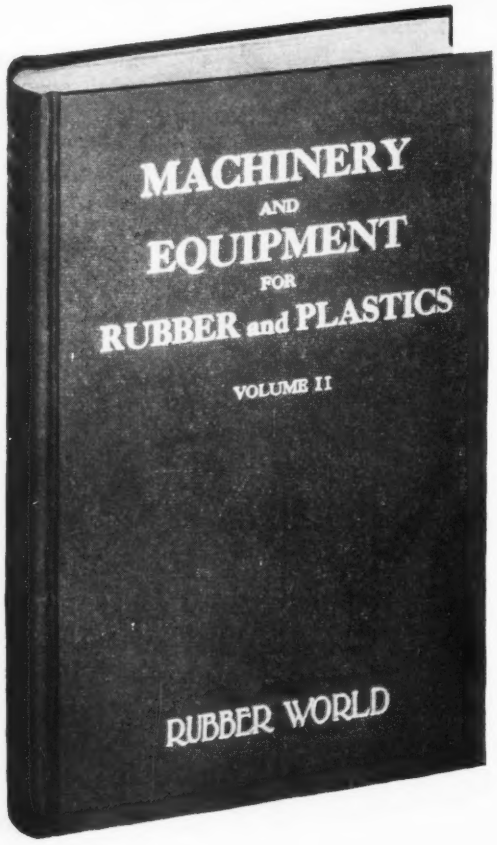

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Market Reviews

Sheeting*

40-inch, 3.15, 64x64	*yd.*	$0.2175
3.60, 56x56		.185
52-inch, 3.85, 48x48		.2275
57-inch, 3.47, 48x48		.235
60-inch, 2.10, 64x64		.36
2.40, 56x56		.31

Sateens*

53-inch, 1.12, 96x60	*yd.*	.565
1.32, 96x64		.52
57-inch, 1.04, 96x60		.615
58-inch, 1.02, 96x60		.625
1.21, 96x64		.5725

Chafer Fabrics*

14.40-oz./sq.yd. P.Y.	*lb.*	.67
11.65-oz./sq.yd. S.Y.		.61
10.80-oz./sq.yd. S.Y.		.61
8.9-oz./sq.yd. S.Y.		.67
40-inch, 2.56, 35x25		.25
60-inch, 1.71, 35x25		.435

News from Abroad

(*Continued from page 138*)

THE SINGAPORE CHAMBER OF COMMERCE RUBBER ASSOCIATION has advised The Rubber Manufacturers Association, Inc., and the Rubber Trade Association of New York that it is willing to postpone the discussion of rubber quality problems, originally asked for by the SCCRA for early 1959, until the next meeting of the International Rubber Study Group scheduled for Kuala Lumpur, Malaya, in the Spring of 1960. Certain problems have arisen since the adoption of the new International Type standards authored by the RMA two years ago. The RMA and the RTANY had taken the position that discussion should be delayed until 1960.

According to technical cooperation agreements between Ceylon and Russia, the latter will aid the Ceylon Government to operate a factory for the production of automobile tires and tubes. Russian experts are expected to arrive in Ceylon shortly to arrange details of the scheme.

C.S.R.-DOW PTY., LTD., recently was formed in Australia by Dow Chemical Co., and C.S.R. Chemicals Pty., Ltd., a leading chemical manufacturer, to produce styrene monomer in a plant to be built near Melbourne. The plant will be part of a four-unit petrochemical complex expected to be completed by mid-1961, and the styrene produced will supply a factory for SBR synthetic rubber that is to be built near by as well as the C.S.R. polystyrene plant in Sydney. The necessary ethylene will come from a plant to be erected by the Australian affiliate of Standard Vacuum Oil Co. This same Australian plant will also supply ethylene to a Union Carbide subsidiary which intends to produce polyethylene.

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STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1958						
Jan.	6,289	5,998	788	785	7,571	13,860
Feb.	7,013	3,852	765	671	5,288	12,301
Mar.	7,147	4,880	759	787	6,426	13,573
Apr.	6,348	3,889	907	830	5,626	11,974
May	4,121	3,635	808	882	5,325	9,446
June	4,323	4,539	696	890	6,125	16,573
July	3,158	3,645	677	893	5,215	13,588
Aug.	5,140	5,474	892	1,103	7,469	12,609
Sept.	5,034	6,165	1,075	1,173	8,413	13,447
Oct.	6,994	7,617	1,170	1,308	10,095	17,089
Nov.	4,074	7,307	1,156	1,205	9,668	13,744
Dec.		6,891	986	1,033	8,910	
1959						
Jan.*		7,801	1,049	1,104	9,954	

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Preliminary.

U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	SBR	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1958						
Jan.	14,178	8,222	1,190	2,052	11,464	25,642
Feb.	15,506	7,992	1,251	2,297	11,540	27,046
Mar.	16,825	7,991	1,281	1,974	11,246	28,071
Apr.	17,415	7,756	1,398	1,744	10,898	28,313
May	17,604	7,240	1,292	1,732	10,264	27,868
June	17,078	7,337	1,267	1,888	10,492	27,570
July	15,516	6,693	1,312	1,990	9,995	25,511
Aug.	13,750	7,166	1,195	2,049	10,410	24,160
Sept.	12,482	6,842	1,354	2,096	10,292	22,774
Oct.	10,324	7,129	1,365	2,229	10,723	21,047
Nov.	8,795	7,810	1,498	2,530	11,838	20,633
Dec.	8,900	7,672	1,563	2,519	11,754	20,654
1959						
Jan.*	10,025	7,822	1,551	2,418	11,791	21,816

* Preliminary.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1958					
Jan.	14,109	1,626	2,649	513	18,897
Feb.	9,947	1,415	2,626	378	14,366
Mar.	15,647	757	3,424	410	20,238
Apr.	11,583	949	2,356	698	15,586
May	14,067	1,218	2,899	784	18,968
June	11,995	1,022	1,562	473	15,052
July	10,602	1,051	2,403	674	14,730
Aug.	8,521	972	2,603	558	12,654
Sept.	8,802	812	2,774	518	12,906
Oct.	12,292	1,407	2,547	553	16,799
Nov.	11,872	1,306	3,010	639	16,827
Dec.	12,602	1,258	2,459	506	16,825

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	SBR Types	Butyl	Neoprene	N-type	Total Natural and Synthetic
1958						
Jan.	42,597	60,179	4,508	5,928	2,010	115,222
Feb.	36,711	52,962	4,255	5,045	1,968	100,941
Mar.	38,191	54,816	4,297	4,965	1,962	104,231
Apr.	36,608	55,133	4,621	4,962	1,897	103,221
May	36,014	55,463	4,258	4,805	1,778	102,318
June	37,607	58,507	4,402	4,844	2,053	107,413
July	34,235	53,903	3,791	4,454	1,717	98,190
Aug.	39,444	59,458	4,277	5,719	2,308	111,206
Sept.	44,814	64,860	4,725	6,405	2,471	123,275
Oct.	48,957	73,242	4,982	7,105	2,686	136,972
Nov.	43,101	65,883	4,419	6,211	2,500	122,114
Dec.	46,963	71,290	4,897	6,701	2,540	132,391
1959						
Jan.*	49,913	74,222	5,359	7,198	2,857	139,549

* Preliminary.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1958				
Jan.	21,159	21,186	892	29,569
Feb.	18,319	18,130	665	28,838
Mar.	19,601	19,300	1,025	28,984
Apr.	19,818	19,746	832	29,440
May	18,942	20,104	1,012	27,862
June	20,549	20,652	1,024	27,763
July	18,136	18,350	1,087	26,442
Aug.	22,432	19,347	900	27,961
Sept.	22,641	21,771	1,005	26,676
Oct.	26,524	23,563	1,028	27,340
Nov.	22,450	21,271	1,051	27,680
Dec.	24,800	23,236	821	28,563
1959				
Jan.*	25,790	25,002		27,157

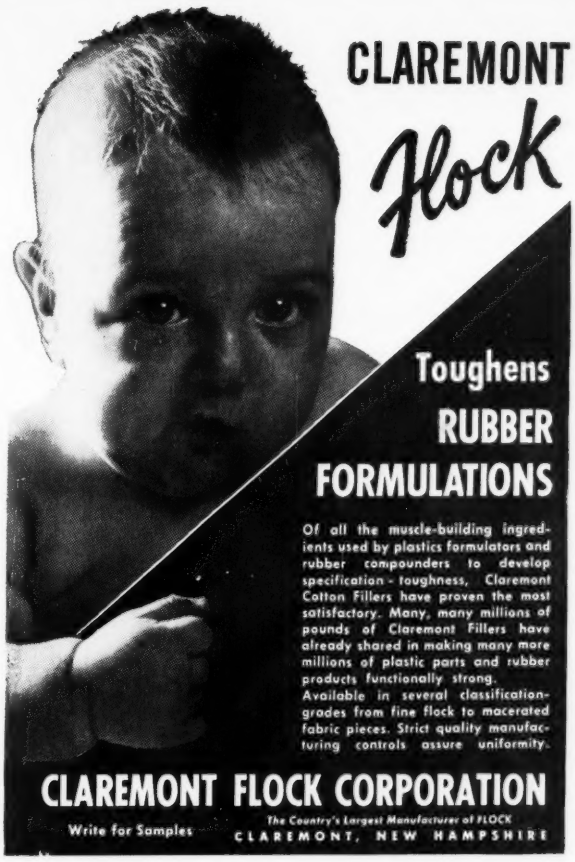
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Preliminary.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR Types	Butyl	Neoprene	N-Type	Total
1958					
Jan.	152,441	31,753	18,691	7,512	210,397
Feb.	151,501	31,369	18,408	7,635	208,914
Mar.	153,221	30,796	18,504	6,947	209,468
Apr.	143,981	30,012	18,764	6,469	199,226
May	137,277	29,246	19,014	6,392	191,929
June	132,800	25,954	18,736	6,231	183,721
July	132,303	24,882	18,242	6,097	181,524
Aug.	136,735	24,618	16,344	6,224	183,921
Sept.	138,987	22,554	15,154	6,145	182,840
Oct.	134,613	22,091	15,474	6,356	178,534
Nov.	140,673	20,192	15,373	7,273	183,511
Dec.	143,533	18,770	15,488	7,292	185,083
1959					
Jan.*	147,243	16,827	15,638	7,335	187,043

* Preliminary.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.



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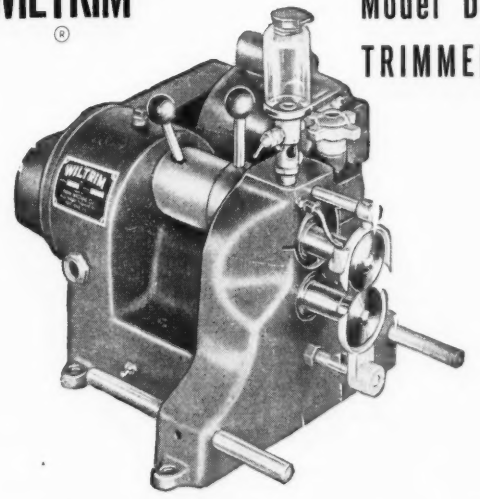

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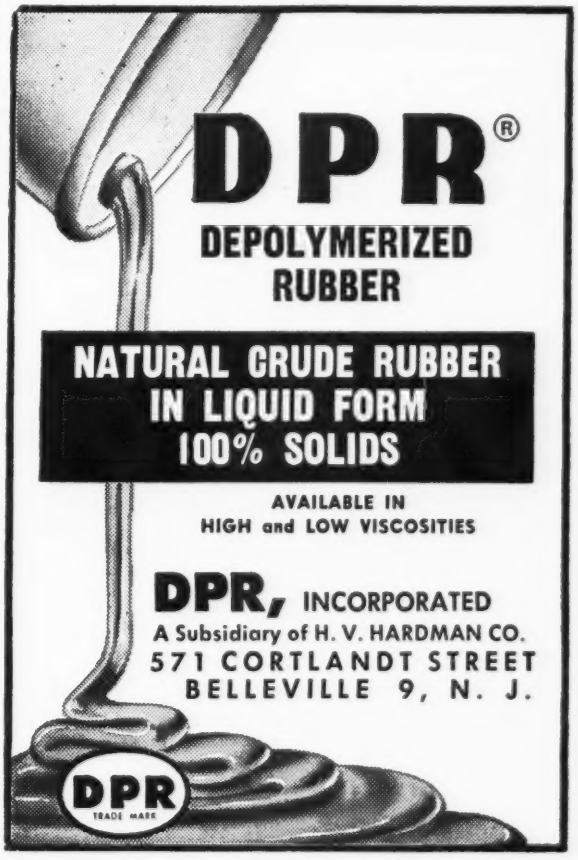

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World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	Eastern Europe and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1955	634.8	56.2	246.2	900.2	1,202.7	1,837.5
1956	562.1	295.0	192.8	841.7	1,330.4	1,892.5
1957	539.8	263.5	181.6	885.5	1,330.2	1,870.0
1958						
Jan.	42.6	21.8	15.3	73.5	110.6	152.5
Feb.	36.7	30.5	16.1	71.5	118.1	155.0
Mar.	38.2	31.6	16.9	73.7	122.2	160.0
Apr.	36.6	43.0	13.4	72.8	115.6	165.0
May	36.0	28.7	14.7	71.6	100.3	150.0
June	37.6	43.7	16.1	74.6	129.9	167.5
July	34.2	27.9	12.7	74.0	115.8	150.0
Aug.	39.4	33.4	8.7	60.6	102.7	147.5
Sept.	44.8	49.3	16.8	78.7	145.2	192.5
Oct.	48.9	40.5	14.2	82.1	136.8	185.0
Nov.	43.1	32.7	14.2	...	...	170.0
Dec.	47.0	...	17.0	...	...	187.5
Total	485.2	...	175.5	...	...	1,995.0

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; and Secretariat of the International Rubber Study Group.
* Estimated.

World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya Estate	Malaya Native	Indonesia Estate	Indonesia Native	All Other	Total
1955	352.9	286.2	261.3	472.4	521.2	1,895.0
1956	353.0	247.4	259.0	427.8	532.9	1,887.5
1957	369.8	268.9	252.2	432.3	556.7	1,892.5
1958						
Jan.	35.8	25.4	22.5	11.5	52.5	145.0
Feb.	28.8	22.9	20.0	8.8	37.0	117.5
Mar.	28.4	20.3	19.7	27.5	46.5	142.5
Apr.	26.7	18.3	16.8	24.0	44.2	130.0
May	27.2	18.2	17.7	20.1	44.3	127.5
June	31.2	21.9	19.7	26.0	43.7	142.5
July	36.5	23.8	20.8	45.3	48.5	175.0
Aug.	34.0	24.8	19.5	42.9	48.8	170.0
Sept.	33.8	23.6	19.0	38.6	52.5	167.5
Oct.	35.1	23.7	20.1	43.4	52.7	175.0
Nov.	31.9	19.8	20.1	43.3	52.4	167.5
Dec.	41.5	30.1	21.5	45.8	51.1	190.0
1958 Total	390.9	272.7	237.4	377.1	576.9	1,855.0

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce; Secretariat of the International Rubber Study Group.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1955	894.9	40.2	20.5	78.5	1,057.5
1956	877.3	48.4	39.5	110.5	1,135.0
1957	929.3	47.5	57.4	154.8	1,262.5
1958					
Jan.	72.6	3.5	5.2	14.0	100.0
Feb.	64.2	3.5	5.2	13.5	92.5
Mar.	66.0	3.5	6.6	13.8	97.5
Apr.	66.6	3.8	4.7	13.5	95.0
May	66.3	4.0	5.5	13.3	95.0
June	69.8	4.5	6.0	13.8	100.0
July	63.9	3.9	4.7	13.5	92.5
Aug.	71.8	3.0	3.1	10.3	95.0
Sept.	78.5	4.2	5.8	14.0	110.0
Oct.	88.0	4.1	4.8	14.0	120.0
Nov.	79.0	4.3	5.2	...	110.0
Dec.	85.4	4.3	6.2	...	115.0
1958 Total	872.2	46.7	63.0	...	1,225.0

Source: Secretariat of the International Rubber Study Group; and Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
*Includes latices.
† Figures estimated or partly estimated.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany	Total
1955	970.5	103.9	10.9	1,085.3
1956	1,079.6	120.7	10.7	1,211.0
1957	1,118.3	132.1	11.6	1,262.0
1958				
Jan.	102.7	10.9	1.8	115.4
Feb.	81.8	9.1	1.0	91.9
Mar.	83.6	11.3	1.2	96.2
Apr.	73.8	11.1	1.1	85.9
May	76.4	11.2	1.2	88.8
June	74.1	10.2	1.1	85.4
July	77.1	11.2	2.6	91.0
Aug.	87.3	10.9	2.3	100.5
Sept.	90.9	11.5	2.2	104.7
Oct.	100.9	12.5	2.4	115.9
Nov.	102.5	12.1	3.1	117.7
Dec.	101.6	12.9	...	...
1958 Total	1,052.8	135.0	...	...

Source: Secretariat of the International Rubber Study Group; and Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	SBR Types	Butyl	Neoprene	N-type	Total Natural and Synthetic
1955	637,577	801,145	56,179	91,357	32,623	1,616,478
1956	579,217	877,430	75,922	99,412	34,567	1,667,841
1957	553,043	907,534	66,936	110,721	33,124	1,671,358
1958						
Jan.	45,564	85,379	6,149	8,804	2,384	148,280
Feb.	46,018	66,402	4,996	8,200	2,157	127,773
Mar.	39,885	69,230	4,698	7,671	2,042	123,526
Apr.	41,278	59,263	4,324	7,973	2,197	115,035
May	36,183	62,161	4,462	7,450	2,338	112,594
June	28,279	62,567	1,926	7,251	2,306	102,329
July	25,823	64,944	3,698	6,248	2,193	102,906
Aug.	39,057	73,338	4,455	6,745	2,783	126,378
Sept.	41,343	75,111	4,117	8,586	3,165	132,322
Oct.	45,136	82,741	5,338	9,283	3,619	136,022
Nov.	41,819	84,382	4,145	10,394	3,575	134,647
Dec.	...	85,270	3,933	9,201	3,217	...
1959						
Jan.*	...	90,261	4,992	9,991	3,260	...

*Preliminary.
Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	SBR	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1957	75,009	68,305	9,539	10,230	88,074	163,083
1958						
Jan.	6,380	5,438	806	683	6,927	13,307
Feb.	5,380	4,475	640	806	5,921	11,301
Mar.	5,560	4,708	633	720	6,061	11,621
Apr.	4,847	4,093	707	797	5,597	10,444
May	5,004	4,102	785	795	5,682	10,686
June	5,304	4,165	639	919	5,723	11,027
July	4,531	3,433	629	703	4,765	9,296
Aug.	6,094	4,654	764	1,025	6,443	12,537
Sept.	6,748	5,779	820	1,017	7,616	14,364
Oct.	7,725	6,534	979	1,120	8,633	16,358
Nov.	6,540	6,009	798	1,108	7,915	14,455
Dec.	6,820	6,893	805	1,106	8,804	15,624
1959						
Jan.*	7,184	6,886	925	1,244	9,055	16,239

Source: Bureau of the Census, Industry Division, Chemicals Branch, United States Department of Commerce.
* Preliminary.

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U.S.A. Rubber Industry Economic Indicators

Year	Production Index* All Rubber Products	Total Tires & Tubes	Auto Tires	Truck & Bus Tires	Miscellaneous Rubber Products	% Return† On Sales	On Investment
1956	133	121	123	119	144	4.5	9.0
1957	135	123	134	107	147	4.2	8.5
1958							
Jan.	123	106	111	99	140		
Feb.	120	112	118	104	127		
Mar.	118	108	115	98	128	3.0	5.2
Apr.	115	103	112	91	125		
May	112	102	113	88	121		
June	122	117	131	99	127	3.4	6.4
July	103	96	105	85	108		
Aug.	127	110	118	99	142		
Sept.	137	117	122	109	156	4.5	9.2
Oct.	143	129	131	125	156		
Nov.	145	128	131	124	160		
Dec.	137	128	132	122	146		

* F.R.B. Index of Industrial Production Unadjusted (1947-49 Avg. 100%).
† Base Data F.T.C.-S.E.C. Quarterly Financial Reports—% Calculated by RMA.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1957			
July	108.75	41.2	2.64
Aug.	109.34	40.8	2.68
Sept.	108.40	40.6	2.67
Oct.	108.14	40.5	2.67
Nov.	112.73	41.3	2.73
Dec.	112.34	41.3	2.72
1958			
Jan.	109.62	40.6	2.70
Feb.	109.21	40.6	2.69
Mar.	110.03	40.6	2.71
Apr.	108.14	40.2	2.69
May	110.03	40.6	2.71
June	112.61	41.1	2.74
July	111.52	40.7	2.74
Aug.	112.75	41.0	2.75
Sept.	113.98	41.0	2.78
Oct.	114.67	41.1	2.79
Nov.	117.88	41.8	2.82

Source: BLS, United States Department of Labor.

Carbon Black Statistics—Twelve Months, 1958

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; GPF, general-purpose furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

Production Furnace types	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Thermal	12,159	10,070	11,942	10,436	9,378	9,598	10,282	9,049	9,060	10,601	12,086	13,163
SRF	22,104	17,946	18,714	14,587	14,750	14,094	18,986	18,539	18,799	20,540	22,840	23,775
HMF	5,769	3,190	5,242	4,302	5,257	6,383	5,134	5,463	5,706	5,704	5,505	4,902
GPF	4,470	4,852	4,632	4,872	5,183	4,418	4,874	5,680	5,230	5,028	5,921	5,555
FEF	16,992	16,398	18,272	17,880	13,384	14,141	14,776	17,472	17,714	20,008	18,765	21,703
HAF	39,384	32,054	33,735	42,134	35,256	35,817	40,137	39,389	41,387	40,919	39,931	39,155
SAF	—	728	968	934	67	82	—	47	—	—	—	2,539
ISAF	13,888	14,739	16,522	12,782	11,011	10,007	14,626	16,551	15,066	16,546	16,198	15,131
Total furnace	115,330	99,977	110,027	107,927	94,286	94,540	108,815	112,190	112,962	119,346	121,246	125,923
Contact types	28,574	25,712	27,328	26,051	26,623	26,105	28,134	27,946	26,375	27,457	27,042	27,467
Totals	143,904	125,689	137,355	133,978	120,909	120,645	136,949	140,136	139,337	146,803	148,288	153,390
Shipments Furnace types												
Thermal	12,237	8,648	8,762	10,034	8,126	8,703	9,260	10,121	12,552	13,153	11,151	12,289
SRF	21,706	18,360	19,869	23,201	19,589	18,612	19,796	22,062	23,341	26,578	23,188	24,892
HMF	5,320	5,030	4,355	5,735	4,682	6,066	6,309	5,086	5,561	5,944	5,412	6,424
GPF	5,589	4,793	3,721	4,267	3,945	4,885	5,146	4,947	5,025	5,299	5,974	6,834
FEF	17,609	17,285	16,780	17,988	15,821	14,908	18,607	19,442	19,965	21,453	19,982	21,418
HAF	35,550	32,938	34,433	37,390	36,802	36,620	38,425	39,054	41,014	45,179	41,982	47,055
SAF	531	387	560	358	319	809	769	551	931	1,102	902	645
ISAF	14,359	12,590	14,332	14,310	13,254	13,181	15,489	17,050	15,922	16,886	16,228	18,649
Total furnace	112,901	100,031	102,812	113,283	102,547	103,784	113,801	118,313	124,311	135,594	124,819	138,206
Contact types	25,571	23,072	23,617	25,863	26,091	23,106	23,645	25,058	24,751	30,244	28,723	31,930
Totals	138,472	123,303	126,429	139,146	128,638	137,446	137,446	143,371	149,062	165,838	153,542	170,136
Producers' Stocks, End of Period Furnace types												
Thermal	20,086	21,508	24,688	25,090	23,342	27,237	28,259	27,187	23,695	21,468	22,403	23,277
SRF	75,022	74,608	73,453	64,906	60,123	55,605	54,795	51,312	46,770	40,334	40,069	38,946
HMF	10,674	8,834	9,721	8,288	8,863	9,180	8,005	8,382	8,527	8,285	8,304	6,782
GPF	8,409	8,468	9,379	9,917	11,090	10,623	10,351	11,044	11,249	10,978	10,914	9,635
FEF	32,930	32,043	33,535	33,427	30,990	30,223	26,392	24,422	22,171	21,105	19,888	20,145
HAF	57,104	56,220	55,522	60,266	58,720	57,917	59,629	59,964	60,337	56,077	54,026	46,077
SAF	7,388	7,729	8,137	8,713	8,457	7,730	6,961	6,457	5,526	4,424	3,517	5,393
ISAF	49,406	51,555	53,745	52,217	49,974	46,800	45,937	45,438	44,582	44,242	44,212	40,683
Total furnace	261,019	260,965	268,180	262,824	254,559	245,315	240,329	234,206	222,857	206,913	203,333	190,938
Contact types	83,776	86,216	89,927	89,885	90,417	93,141	97,630	100,518	102,142	99,510	97,829	93,366
Totals	344,795	347,181	358,107	352,709	344,976	338,456	337,959	334,724	324,999	306,423	301,162	284,304
Exports Furnace types												
Total furnace	23,723	22,719	25,720	24,534	21,879	22,417	24,871	21,406	24,325	23,701	26,434	.....
Contact types	13,519	10,933	14,018	12,143	12,698	13,369	10,970	8,953	11,356	11,234	14,472	.....
Totals	37,242	33,652	39,738	36,677	34,577	35,786	35,841	30,359	35,681	34,935	40,906	.....

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

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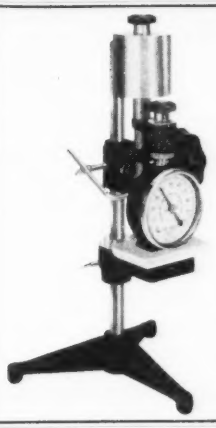

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U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumer's Price Index
		All Rubber Products			
1939	121.0	$27.84	39.9	$0.75	
1957					
Aug.	204.3	92.84	40.9	2.27	121.0
Sept.	206.4	93.02	40.8	2.29	121.1
Oct.	209.5	93.03	40.1	2.32	121.1
Nov.	209.0	93.20	40.0	2.33	121.6
Dec.	207.3	92.40	40.0	2.31	121.6
1958					
Jan.	200.9	87.48	38.2	2.29	122.3
Feb.	191.3	85.04	37.3	2.28	122.5
Mar.	184.0	87.02	38.0	2.29	123.5
Apr.	176.0	85.88	37.5	2.29	123.6
May	172.3	87.86	38.2	2.29	123.7
June	175.8	91.10	39.1	2.33	123.9
July	175.1	91.89	39.2	2.35	123.7
Aug.	181.2	96.80	40.5	2.39	123.7
Sept.	187.5	97.51	40.8	2.39	123.7
Oct.	194.5	97.27	40.7	2.39	123.7
Nov.	195.6	98.33	40.8	2.41	123.9
		Tires and Tubes			
1939	54.2	$33.36	35.0	$0.96	
1957					
Aug.	84.2	107.83	41.0	2.63	
Sept.	84.4	107.20	40.3	2.66	
Oct.	84.4	105 18	39.1	2.69	
Nov.	84.0	106.62	39.2	2.72	
Dec.	83.6	105.84	39.2	2.70	
1958					
Jan.	81.6	98.52	36.9	2.67	
Feb.	78.5	93.02	35.1	2.65	
Mar.	76.0	98.05	37.0	2.65	
Apr.	72.1	95.67	36.1	2.65	
May	70.4	99.48	37.4	2.66	
June	71.2	103.63	38.1	2.72	
July	71.0	106.59	38.9	2.74	
Aug.	72.5	113.96	40.7	2.80	
Sept.	74.1	113.40	40.5	2.80	
Oct.	75.3	113.24	40.3	2.81	
Nov.	76.2	116.03	41.0	2.83	
		Rubber Footwear			
1939	14.8	$22.80	37.5	$0.61	
1957					
Aug.	17.2	73.05	39.7	1.84	
Sept.	17.6	74.45	39.6	1.88	
Oct.	17.7	76.02	39.8	1.91	
Nov.	18.0	78.96	40.7	1.94	
Dec.	17.9	79.35	40.9	1.94	
1958					
Jan.	17.5	74.87	39.2	1.91	
Feb.	17.0	74.68	39.1	1.91	
Mar.	16.7	76.61	39.9	1.92	
Apr.	16.5	75.46	39.3	1.92	
May	16.3	75.85	39.3	1.93	
June	16.3	77.20	40.0	1.93	
July	15.9	75.25	39.4	1.91	
Aug.	16.4	77.18	40.2	1.92	
Sept.	16.8	76.62	39.7	1.93	
Oct.	17.1	77.01	39.9	1.93	
Nov.	17.2	77.22	39.6	1.95	
		Other Rubber Products			
1939	51.9	$23.34	38.9	$0.61	
1957					
Aug.	102.9	83.84	41.1	2.04	
Sept.	104.4	85.08	41.1	2.07	
Oct.	107.4	86.10	41.0	2.10	
Nov.	107.0	85.05	40.5	2.10	
Dec.	105.8	84.03	40.4	2.08	
1958					
Jan.	101.8	80.94	39.1	2.07	
Feb.	95.8	80.32	38.8	2.07	
Mar.	91.3	79.87	38.4	2.08	
Apr.	87.4	79.87	38.4	2.08	
May	85.6	80.29	38.6	2.08	
June	88.3	83.77	39.7	2.11	
July	88.2	83.53	39.4	2.12	
Aug.	92.3	86.24	40.3	2.14	
Sept.	96.6	89.21	41.3	2.16	
Oct.	102.1	88.78	41.1	2.16	
Nov.	102.2	88.54	40.8	2.17	

Source: BLS, United States Department of Labor.

U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1957	32,724	56,605	888	90,217	93,547	19,818
1958						
Jan.	2,376	4,838	50	7,264	6,740	19,298
Feb.	1,998	3,777	57.5	5,833	6,320	19,820
Mar.	1,845	4,726	49.3	6,621	6,569	19,786
Apr.	1,594	5,517	61.4	7,173	6,522	19,051
May	1,874	5,593	55.8	7,523	6,715	18,263
June	1,667	6,387	62.8	8,117	7,306	17,465
July	1,756	6,502	60.0	8,318	6,368	15,490
Aug.	847	5,807	57.2	6,711	6,753	15,535
Sept.	1,170	5,425	63.9	6,659	7,134	16,045
Oct.	1,522	5,369	80.6	6,972	7,983	17,134
Nov.	3,056	3,651	57.7	6,765	7,182	17,420
Dec.	3,701	3,977	61.2	7,739	8,046	17,818
1959						
Jan.	2,631	6,028	56.9	8,716	8,859	17,998
Truck and Bus						
1957	4,041	8,544	845	13,430	13,394	3,408
1958						
Jan.	277	674	57	1,007	1,074	3,470
Feb.	254	598	52	904	994	3,572
Mar.	269	608	46	923	1,004	3,659
Apr.	282	666	55	1,002	955	3,607
May	299	626	54	980	938	3,571
June	265	794	54	1,113	988	3,456
July	265	940	51	1,255	920	3,114
Aug.	208	871	57	1,136	1,009	2,986
Sept.	273	940	41	1,253	1,143	2,880
Oct.	316	1,106	59	1,482	1,361	2,779
Nov.	313	669	42	1,023	1,211	2,983
Dec.	356	734	63	1,153	1,330	3,171
1959						
Jan.	329	714	47	1,090	1,325	3,401
Total Automotive						
1957	36,764	65,150	1,734	103,647	106,941	23,225
1958						
Jan.	3,653	5,511	107	8,271	7,814	22,769
Feb.	2,253	4,374	110	6,737	7,314	23,392
Mar	2,114	5,334	95	7,543	7,573	23,446
Apr.	1,876	6,183	116	8,175	7,477	22,658
May	2,173	6,220	110	8,503	7,652	21,834
June	1,932	7,182	117	9,231	8,293	20,920
July	2,020	7,442	111	9,573	7,288	18,604
Aug.	1,055	6,679	115	7,848	7,762	18,521
Sept.	1,442	6,365	105	7,912	8,277	18,925
Oct.	1,838	6,476	140	8,454	9,344	19,913
Nov.	3,369	4,320	100	7,788	8,393	20,403
Dec.	4,057	4,711	124	8,892	9,376	20,988
1959						
Jan.	2,961	6,742	104	9,806	10,184	21,399

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

	Shipments					
Year	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
1957	3,045	35,684	1,077	39,806	39,763	7,671
1958						
Jan.	232	4,005	71	4,309	3,344	6,699
Feb.	209	3,014	73	3,296	3,443	6,983
Mar.	209	3,481	74	3,764	3,685	7,066
Apr.	223	2,956	64	3,243	3,624	7,609
May	225	2,742	68	3,035	3,530	8,189
June	202	3,332	67	3,601	3,476	8,156
July	215	3,174	76	3,466	2,890	7,680
Aug.	160	3,097	74	3,331	3,305	7,664
Sept.	207	3,228	63	3,498	3,390	7,657
Oct.	244	3,237	84	3,567	3,768	7,869
Nov.	264	2,575	60	2,899	3,319	8,372
Dec.	288	3,029	94	3,411	3,491	8,617
1959						
Jan.	287	4,450	63	4,800	3,806	7,536

Source: The Rubber Manufacturers Association, Inc.

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MIL-C-12064A (CE)

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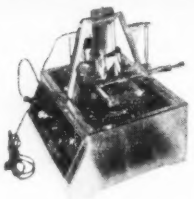

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U.S.A. Rubber Industry Sales and Inventories

(Millions of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1955	1956	1957	1958	1955	1956	1957	1958
Jan.	424	415	496	448	790	935	1,047	1,100
Feb.	440	445	495	413	782	970	1,036	1,087
Mar.	466	451	476	412	805	979	1,030	1,112
Apr.	445	445	490	429	784	970	1,031	1,047
May	465	464	481	428	810	985	1,024	1,020
June	465	450	458	445	850	975	1,027	986
July	471	459	514	478	853	987	1,045	980
Aug.	456	436	481	438	863	1,007	1,074	1,024
Sept.	456	429	481	464	874	1,007	1,074	1,024
Oct.	447	454	490	493	902	1,022	1,097	1,022
Nov.	482	463	431	472	935	1,024	1,101	1,018
Dec.	465	461	427	..	934	998	1,092	..
Total	5,493	5,372	5,720	..	Av. 845	988	12,678	

Source: Office of Business Economics, United States Department of Commerce.
* Adjusted for seasonal variation.

U.S.A. Production of Cotton, Rayon, and Nylon Tire Fabrics

(Thousands of Pounds)

	Cotton and Nylon*				
	Cotton Chafer Fabrics and Other Tire Fabrics	Cotton and Nylon Tire Cord and Fabrics	Rayon Tire Cord		Total All Tire Cord and Fabrics
			Woven	Not Woven	
1957					
Jan.-Mar.	11,028	20,676	69,610	21,872	124,297
Apr.-June	10,456	24,852	63,195	16,037	115,418
July-Sept.	9,102	24,852	54,968	10,509	100,046
Oct.-Dec.	9,207	23,868	58,356	9,216	100,647
1958					
Jan.-Mar.	9,750	18,820	56,522	8,372	167,924
Apr.-June	7,890	24,725	†	†	80,533
July-Sept.	7,999	24,904	†	†	91,984
Oct.-Dec.	10,533	26,392	†	†	107,532

* Preliminary.
* Cotton and nylon figures combined to avoid disclosing data for individual companies.
† Withheld to avoid disclosing figures for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

Femco Die Cutter

(*Continued from page 142*)

that it precompresses and registers the stock before the roller starts cutting action. This eliminates such usual difficulties as stock distortion and stretch. Other claimed advantages are that it will cut heavy gage stock and leaves all of the bed cutting area available for multiple die set-ups.

The horizontal die handling mechanism automatically moves the dies on and off the die cutter bed plate. The cutting action is not directly against the roll, but against a facing of stainless steel. After the lower frame and dies move on to the bed, the vertical handler frame closes with the cutting plate over the material, and the roll passes over the back of the plate, forcing the material into the die cavities. Operations are automatic from the time the stock is positioned until the multiple-cavity die-cut pieces are dumped into a tote box by inverting the lower die frame.

This machine makes possible a complete cutting impression every 10 seconds, exclusive of loading time. Material which may be cut includes foam rubber, urethane foams, curled hair, closed- and open-cell sponge rubber, vinyl foam, supported and unsupported sheet vinyl up to six-ply in some cases, cork to ⅜-inch thick, and uncured stock to ½-inch gage.

Inquiries regarding this new model should go to Falls Engineering & Machine Co., Cuyahoga Falls, O. Campbell Machinery Development Co. of the same address designed the equipment.

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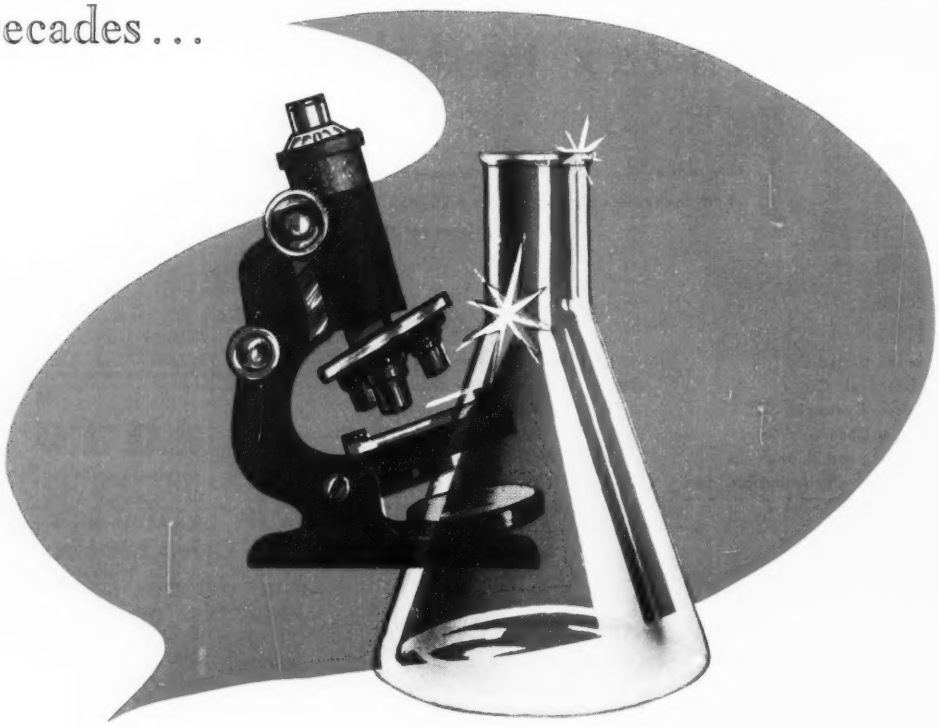

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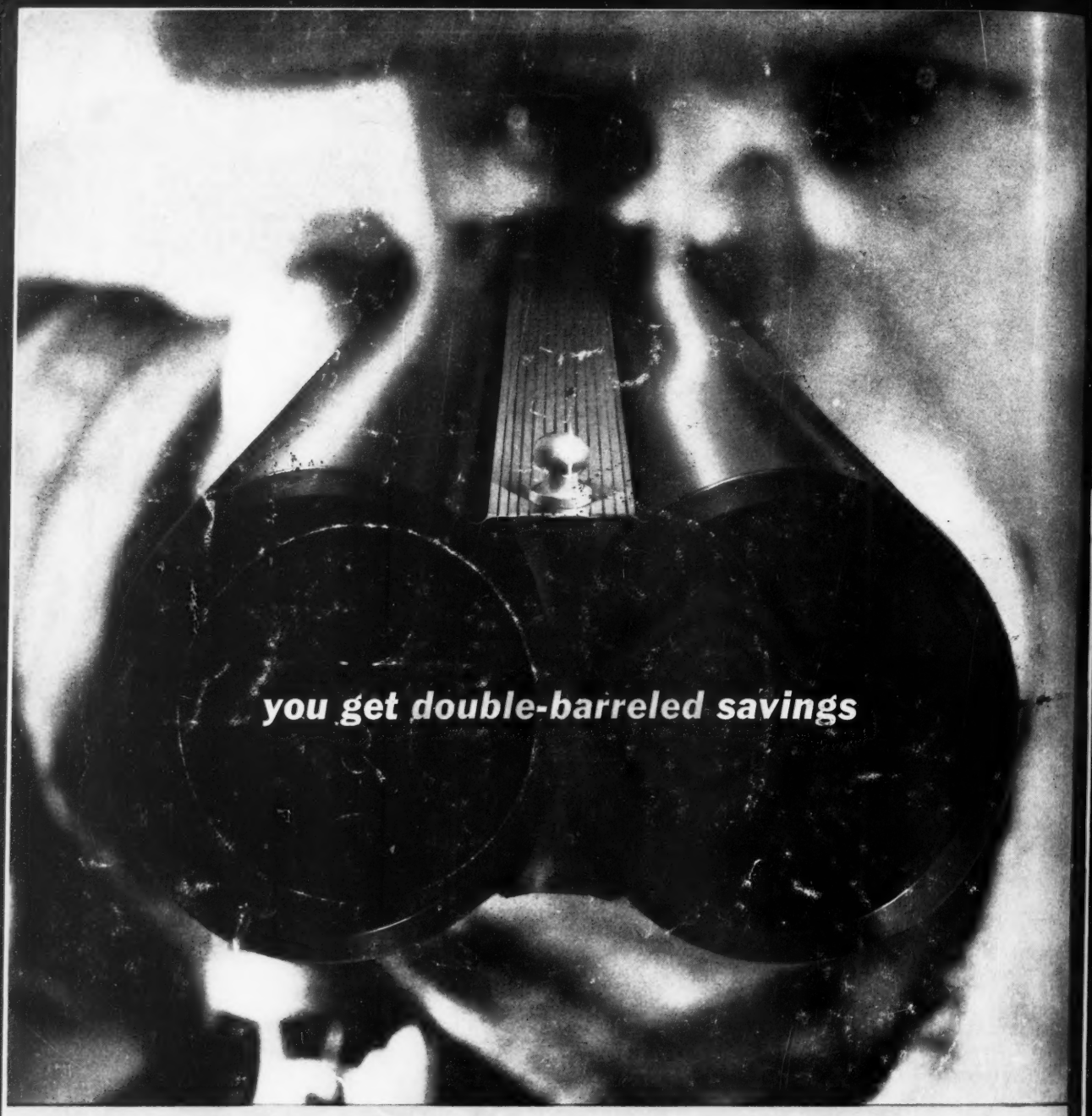

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